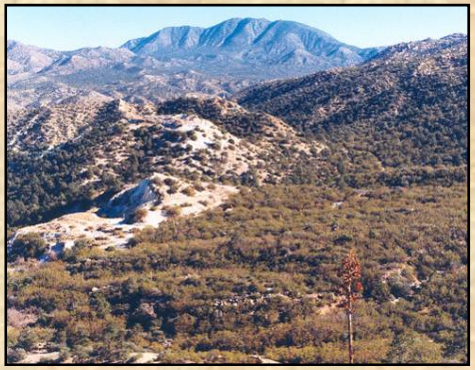
Elevational shifts in breeding bird distributions over a 26-year period in a Southern California desert region

Lori Hargrove
John T. Rotenberry
Department of Biology
UC Riverside



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- CA Desert Research Fund, The Community Foundation
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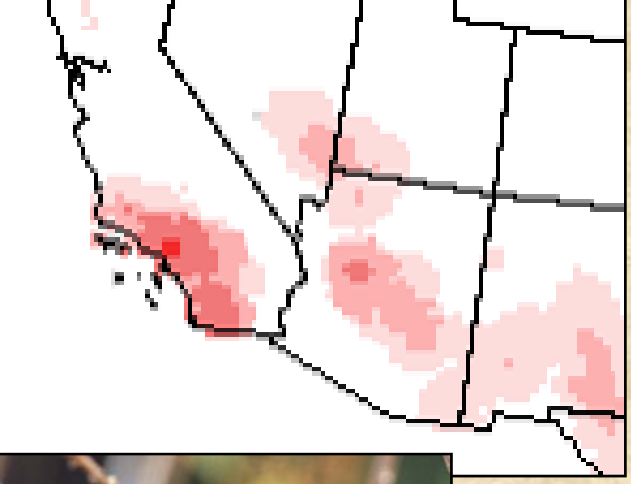
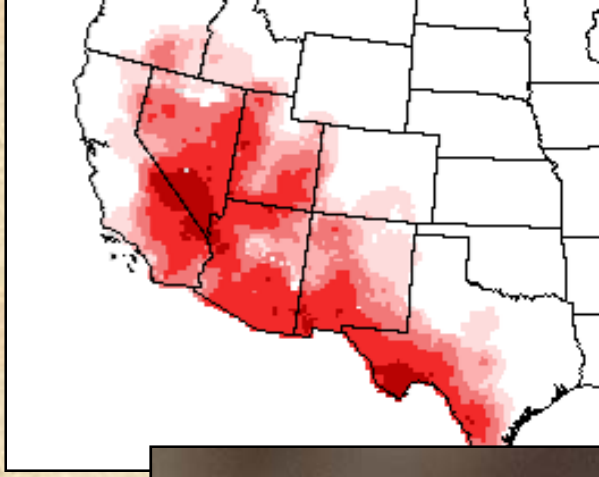
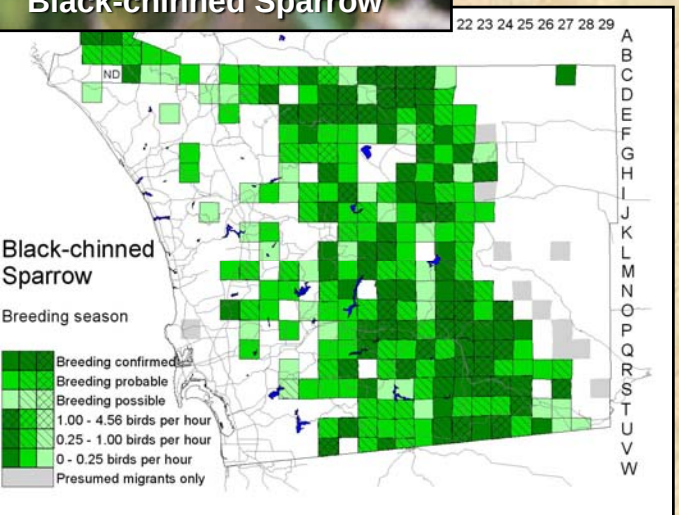
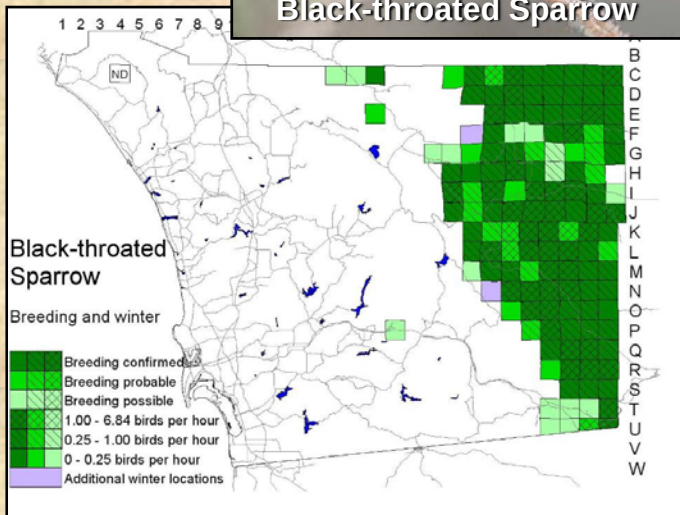
- Rotenberry Lab (UCR)
- Phil Unitt (SDNHM)
- Al Muth and Mark Fisher (Deep Canyon)
- Paul Jorgensen (ABDSP)

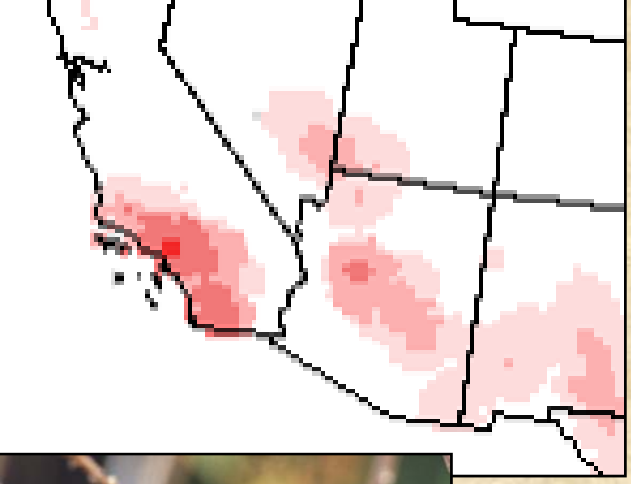


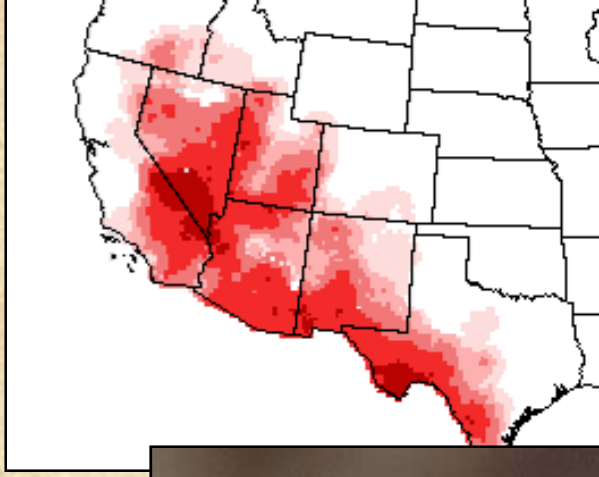


What limits a species' distribution?









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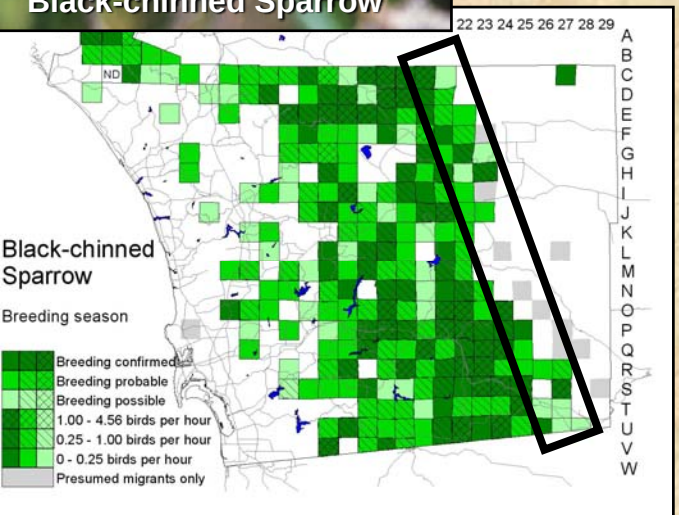

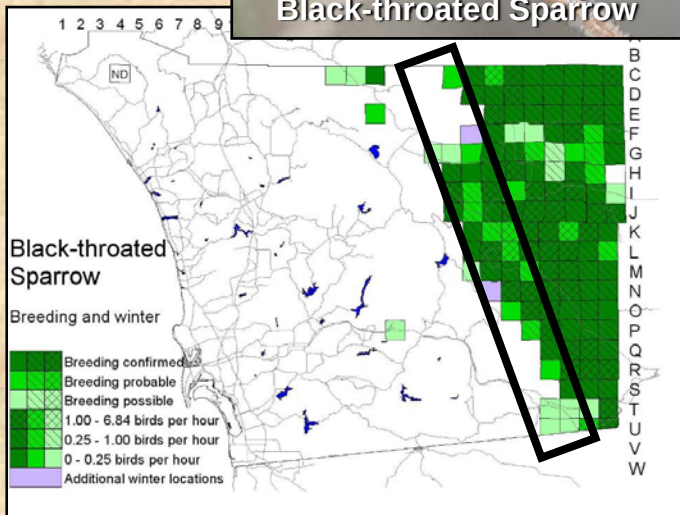

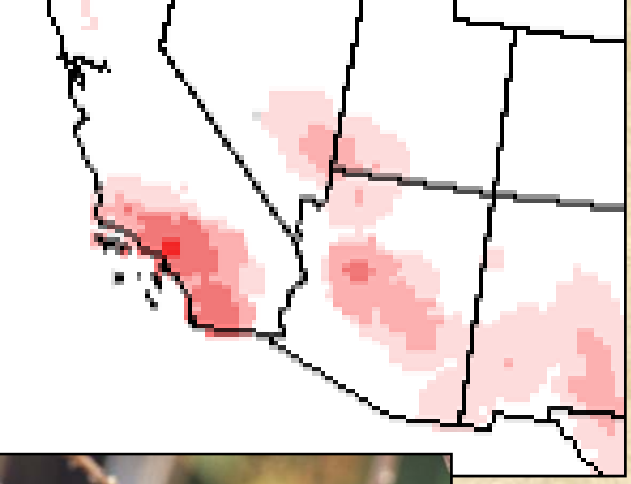

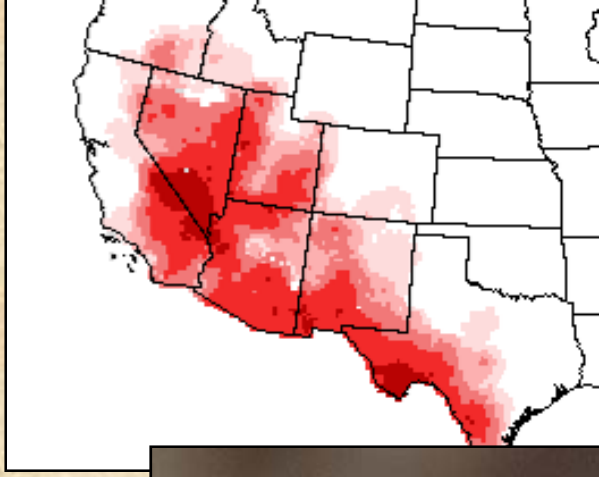

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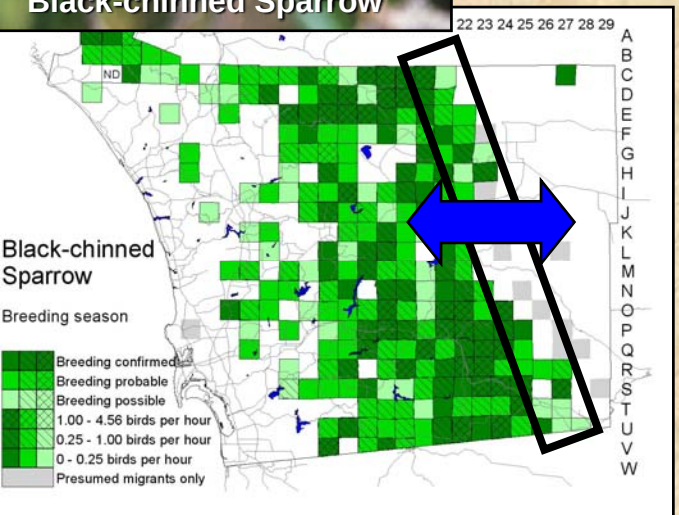

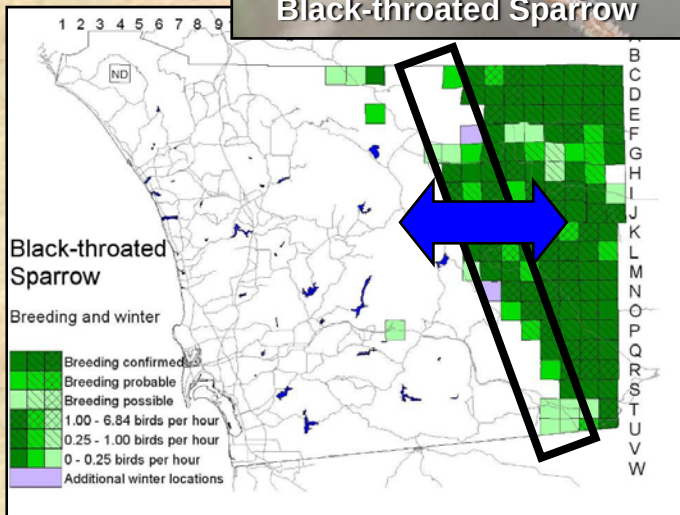

Linking distribution patterns to local breeding performance

1. Distribution patterns along an elevation gradient:
   - Current breeding distributions and habitat associations for multiple bird species
   - 26-year comparison
   - 100-year comparison

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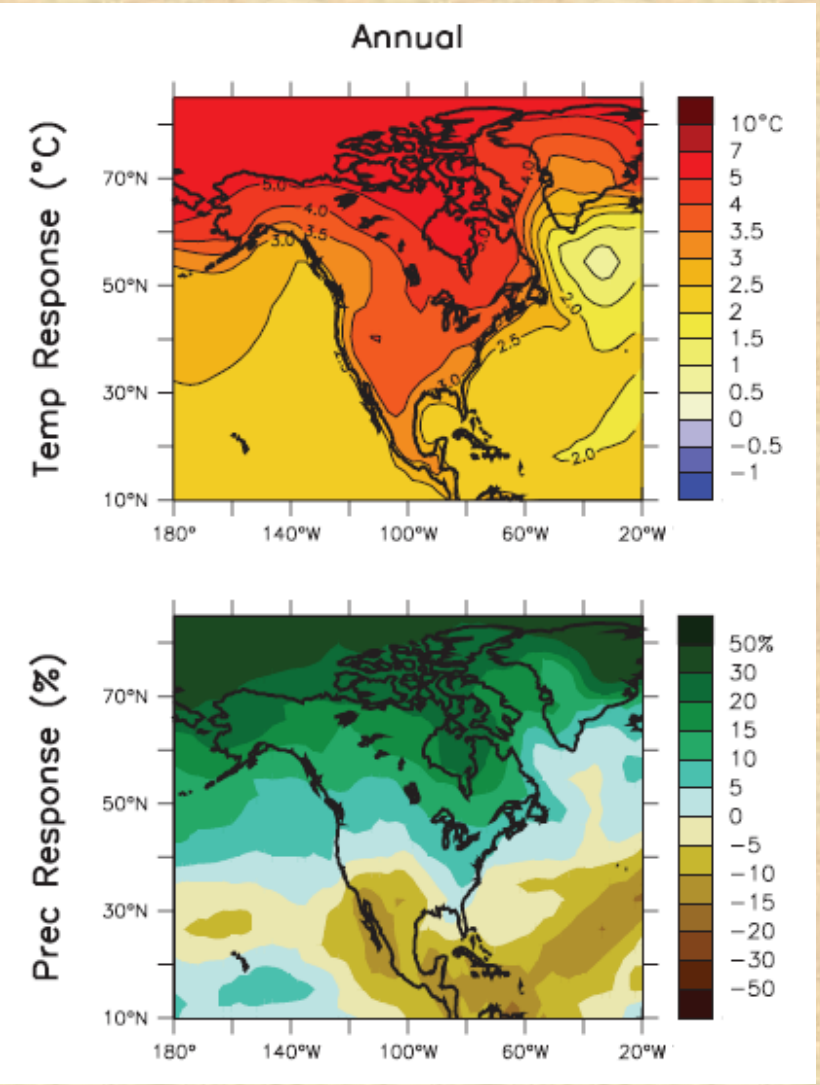
Climate change predictions: Southern California (IPCC 2007)



Next century:

- Temperature increase
  2.5 – 3.5°C

- Precipitation decrease
  5 – 10%

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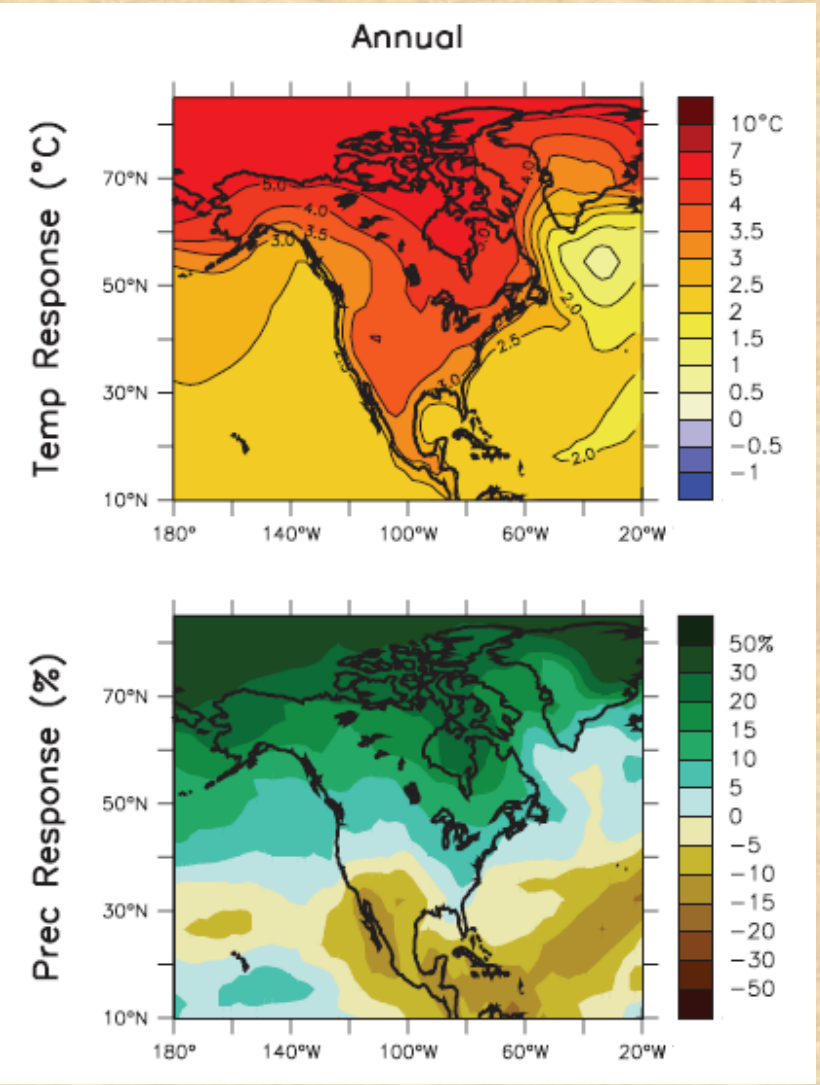

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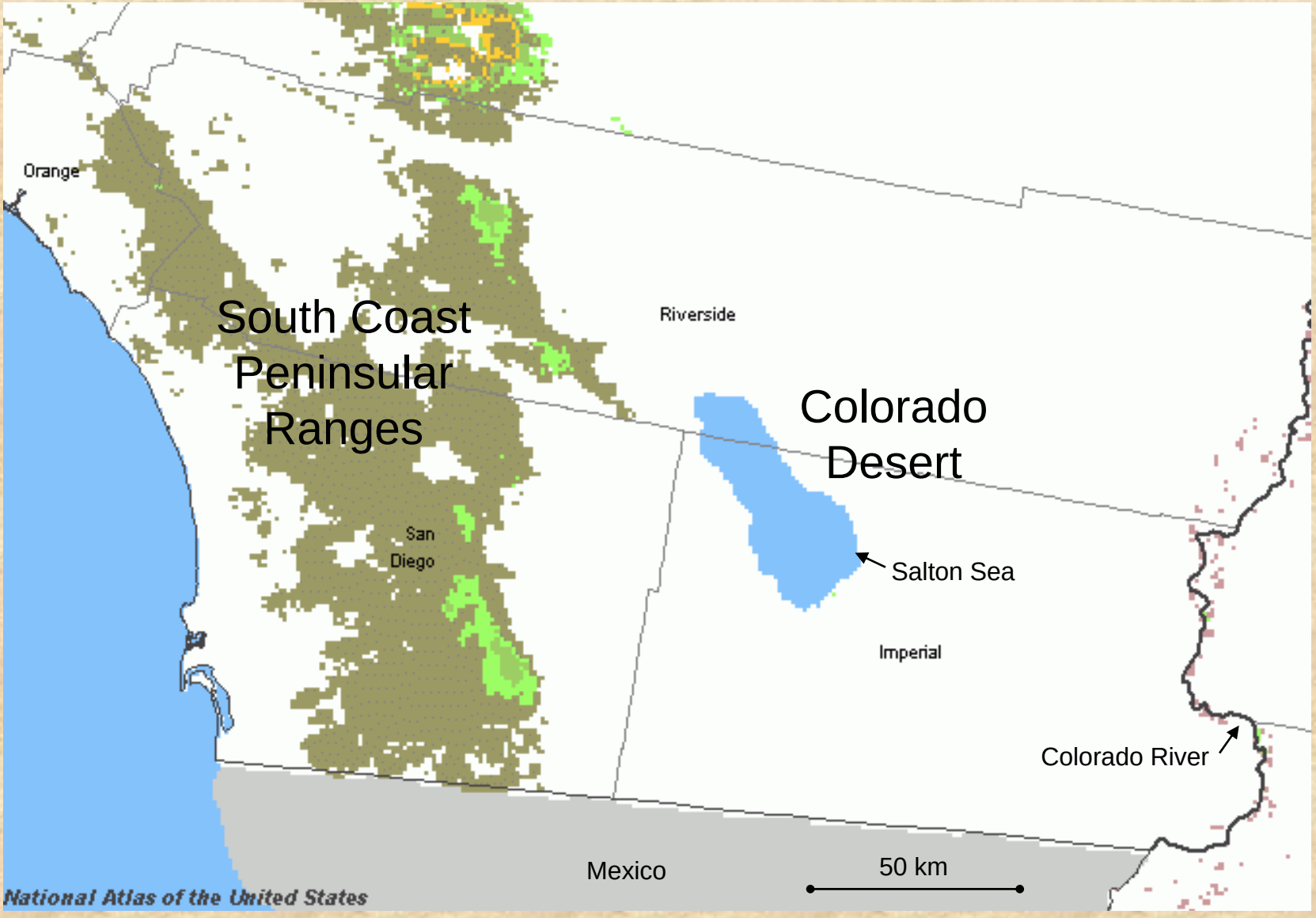
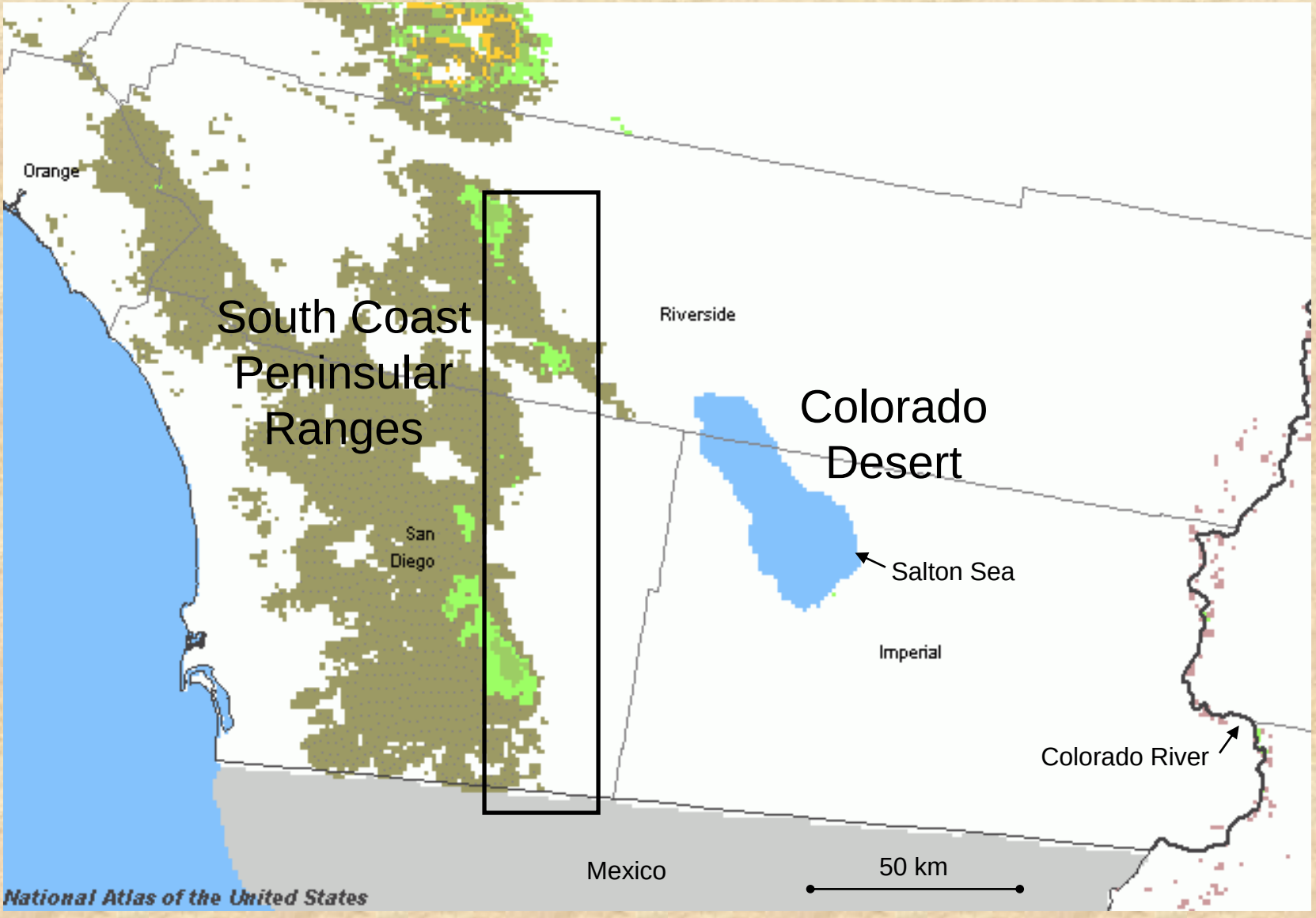
Upward shift in elevational distributions?


Orange
South Coast
Peninsular
Ranges
Riverside
Colorado
Desert
San
Diego
Salton Sea
Imperial
Colorado River
Mexico
50 km
National Atlas of the United States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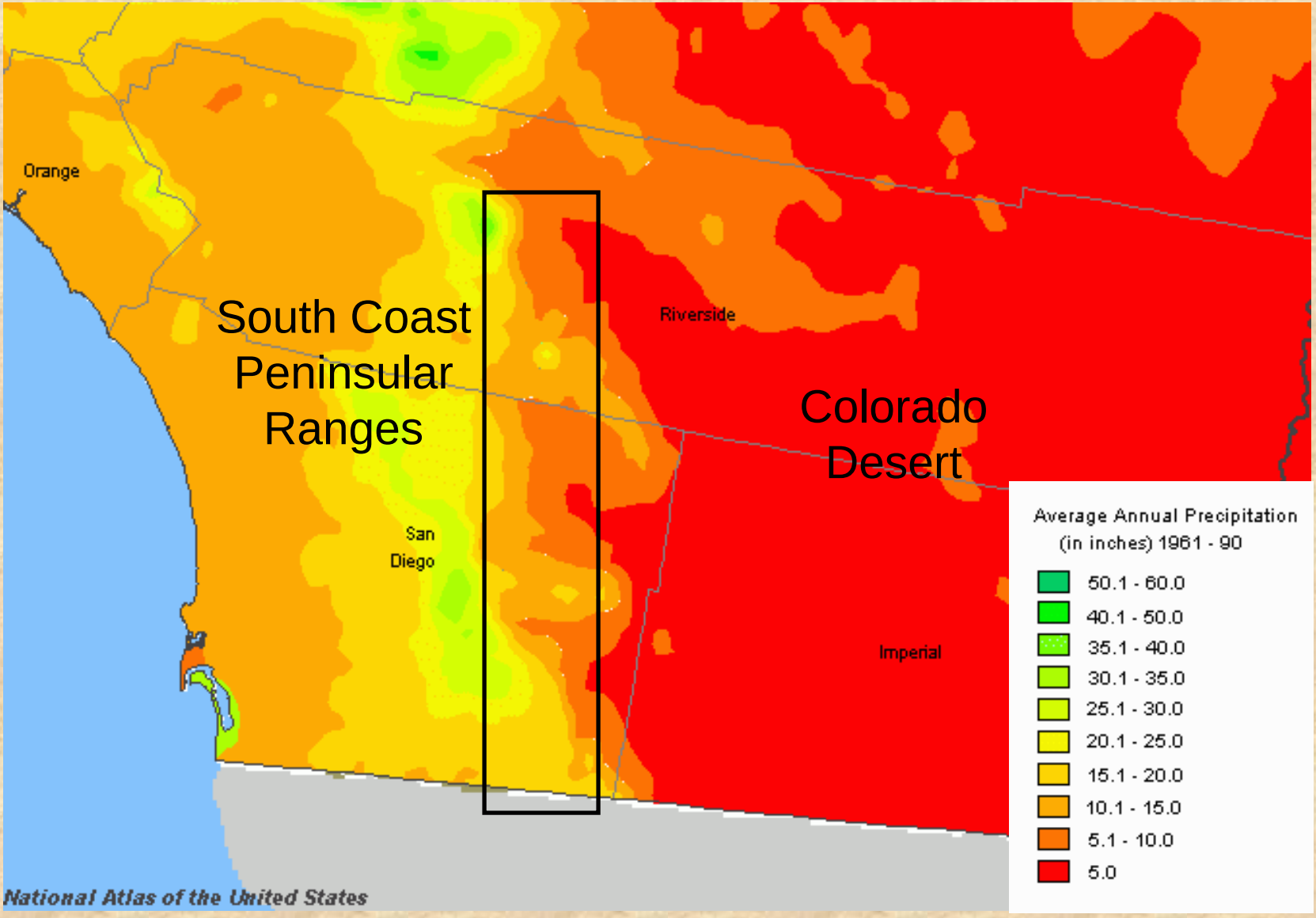
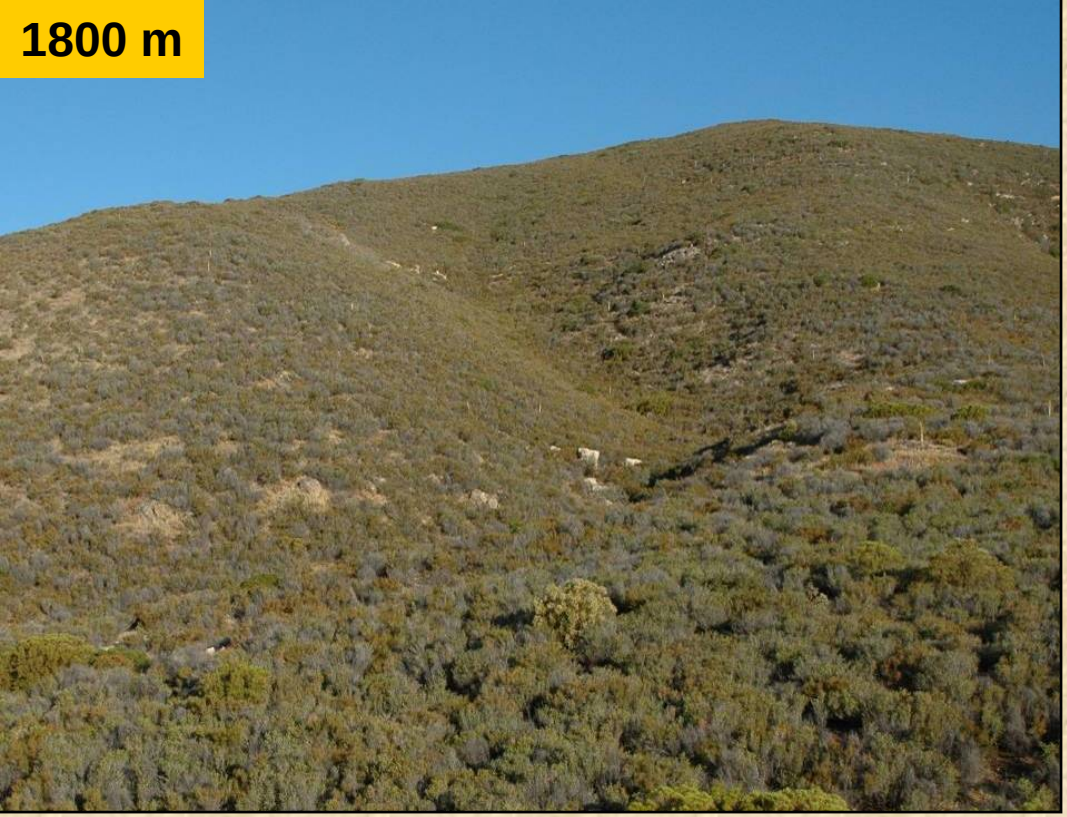
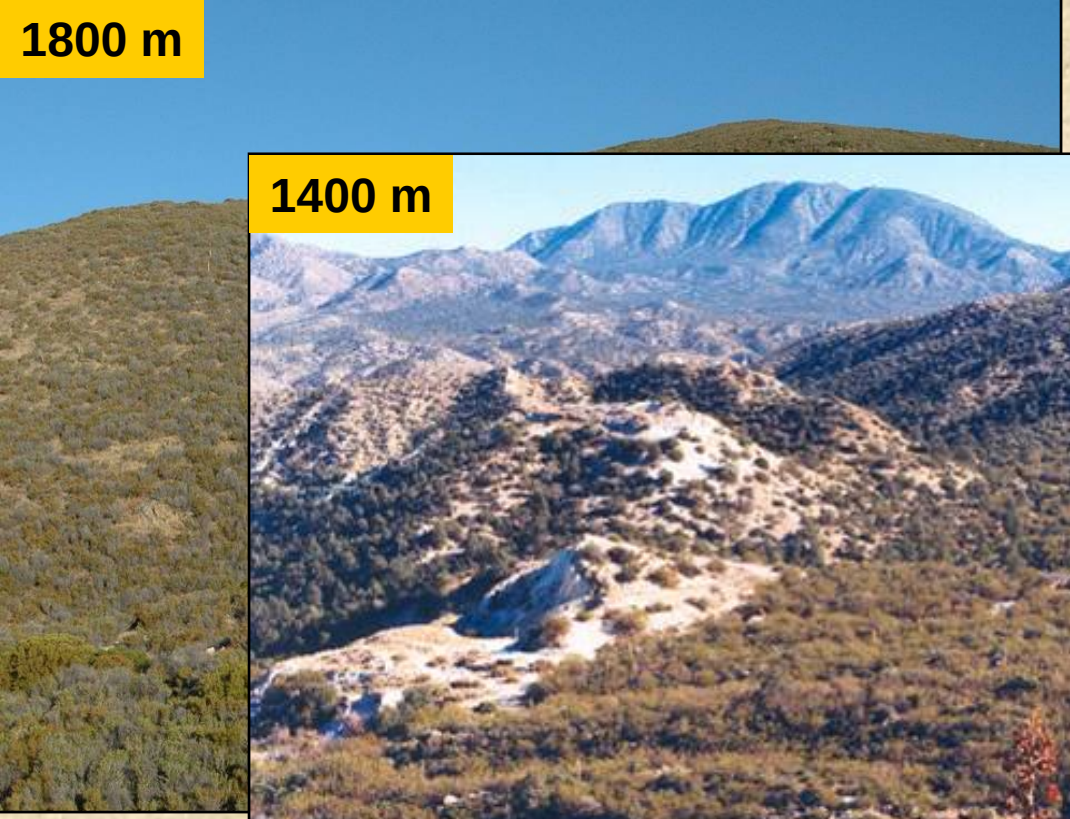
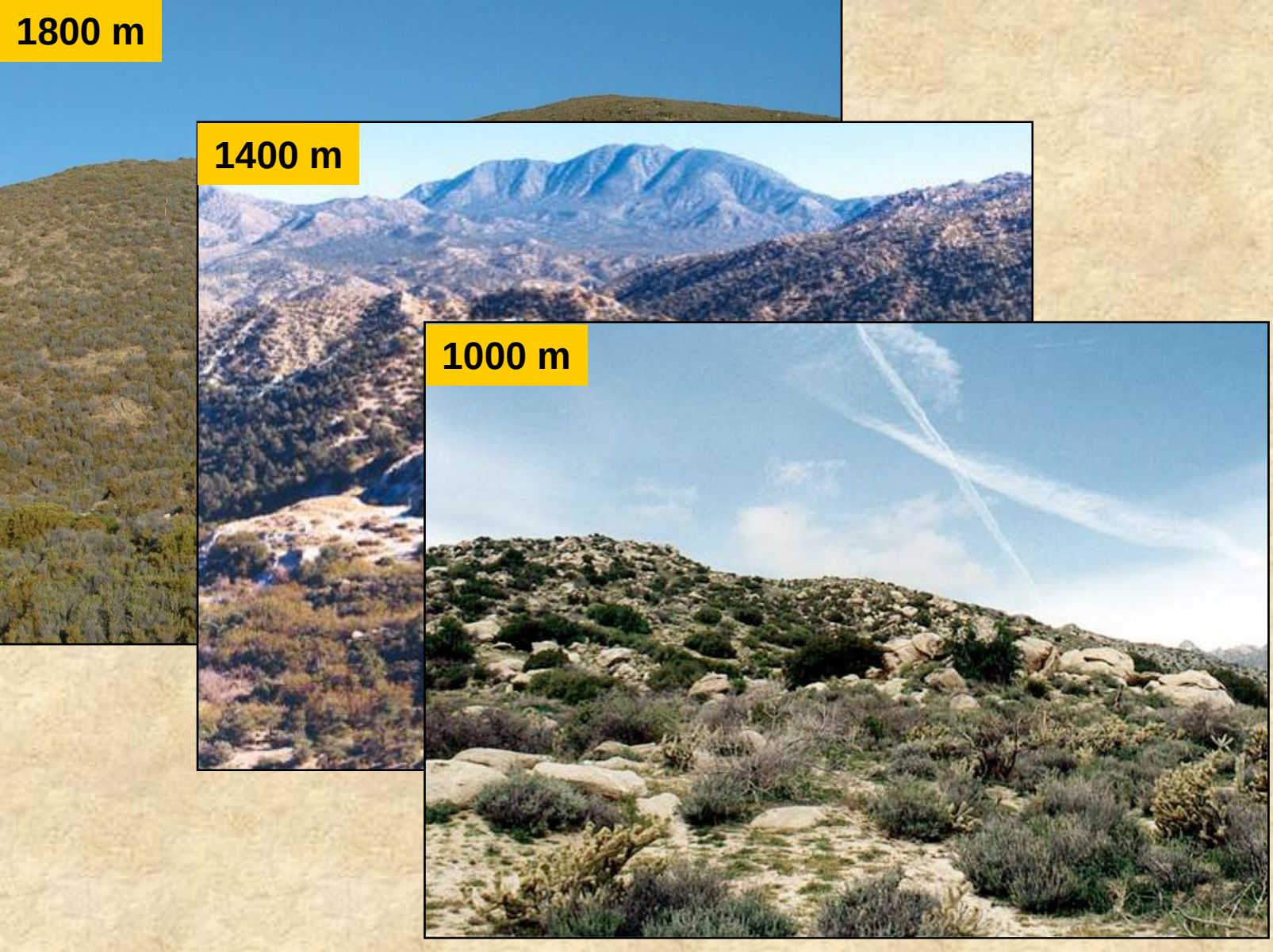
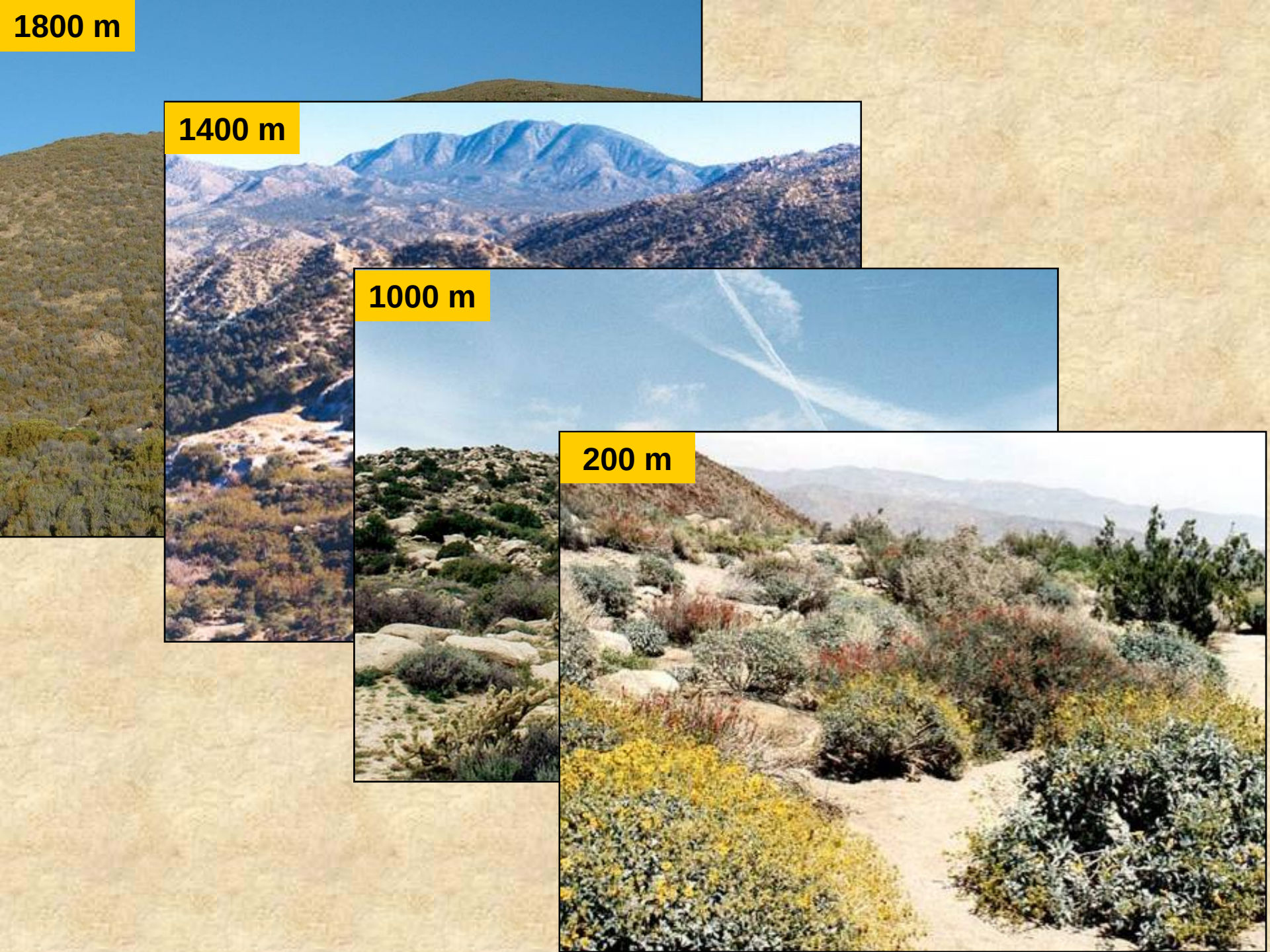

Orange
South Coast
Peninsular
Ranges
Riverside
Colorado
Desert
San
Diego
Imperial
Average Annual Precipitation
(in inches) 1961 - 90
50.1 - 60.0
40.1 - 50.0
35.1 - 40.0
30.1 - 35.0
25.1 - 30.0
20.1 - 25.0
15.1 - 20.0
10.1 - 15.0
5.1 - 10.0
5.0
National Atlas of the United States

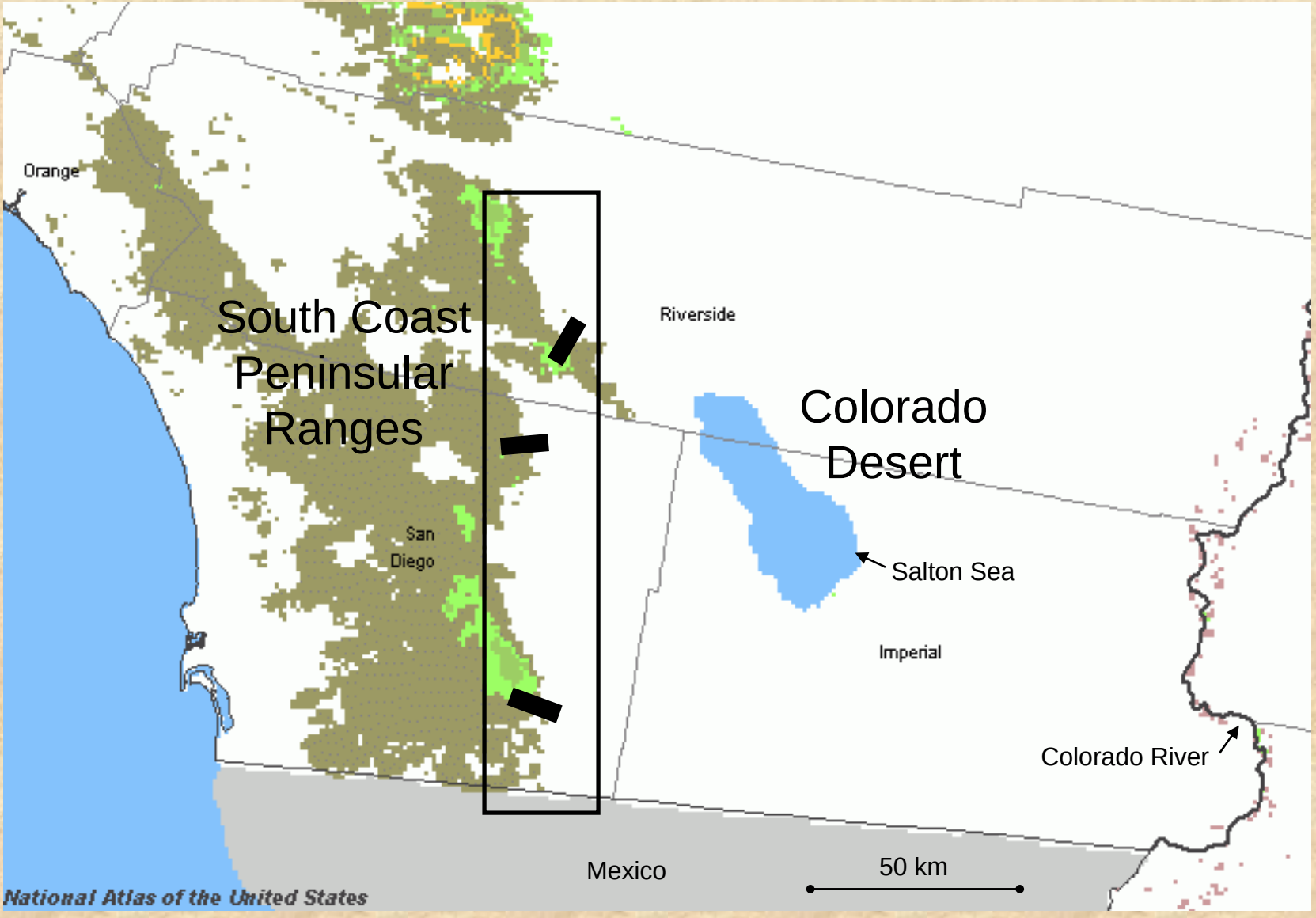

1800 m


1800 m

1400 m


1800 m
1400 m
1000 m


1800 m
1400 m
1000 m
200 m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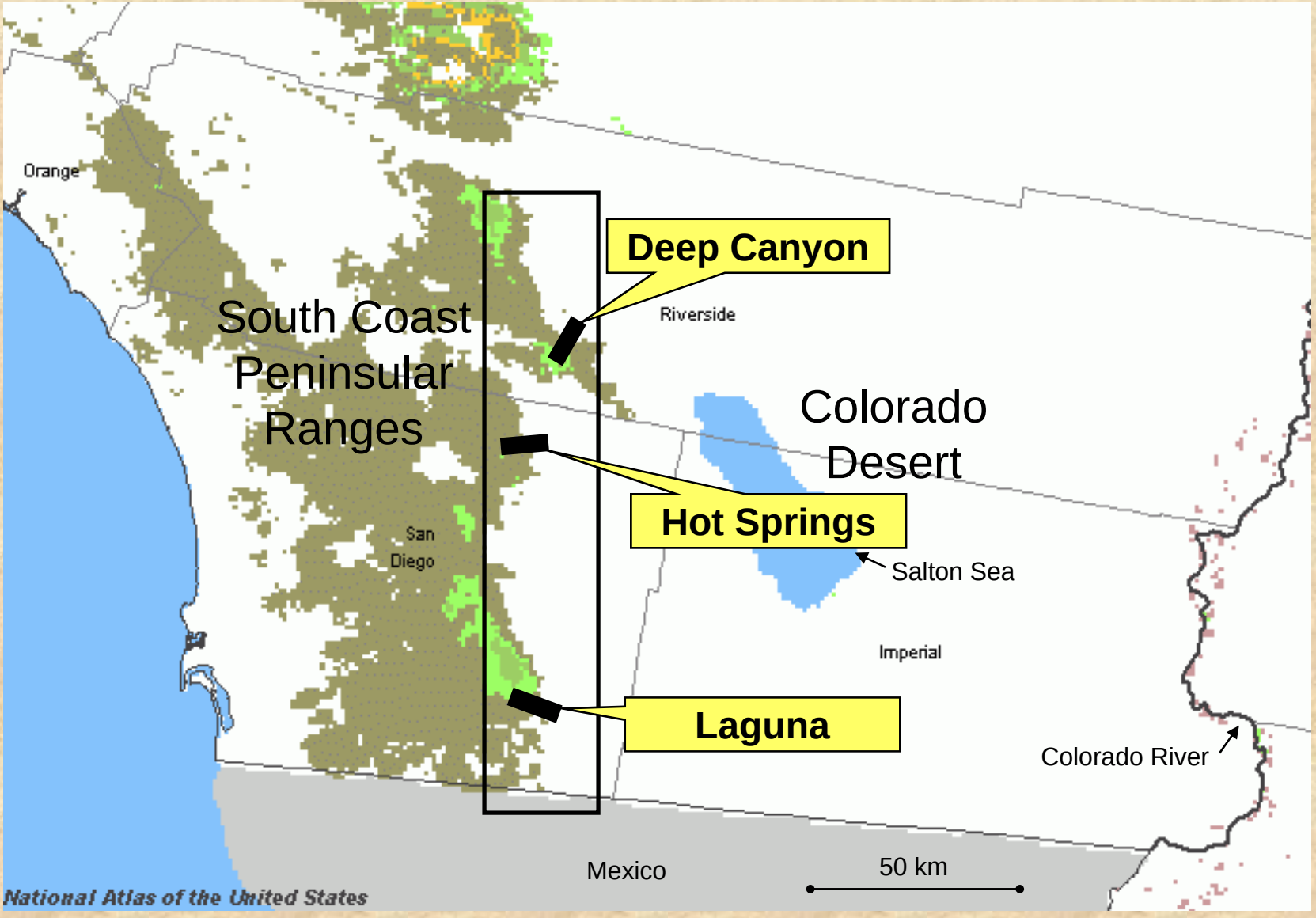
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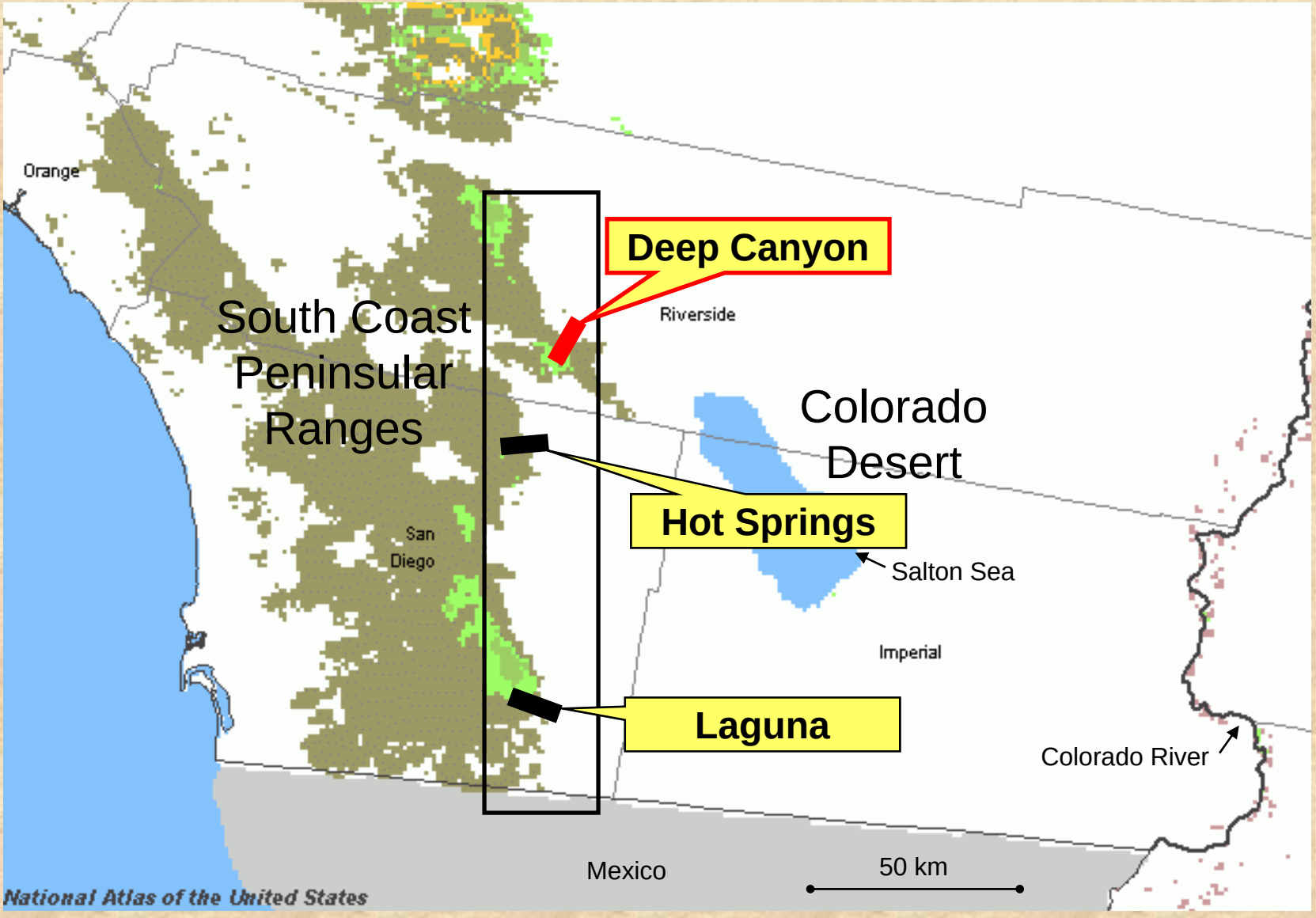
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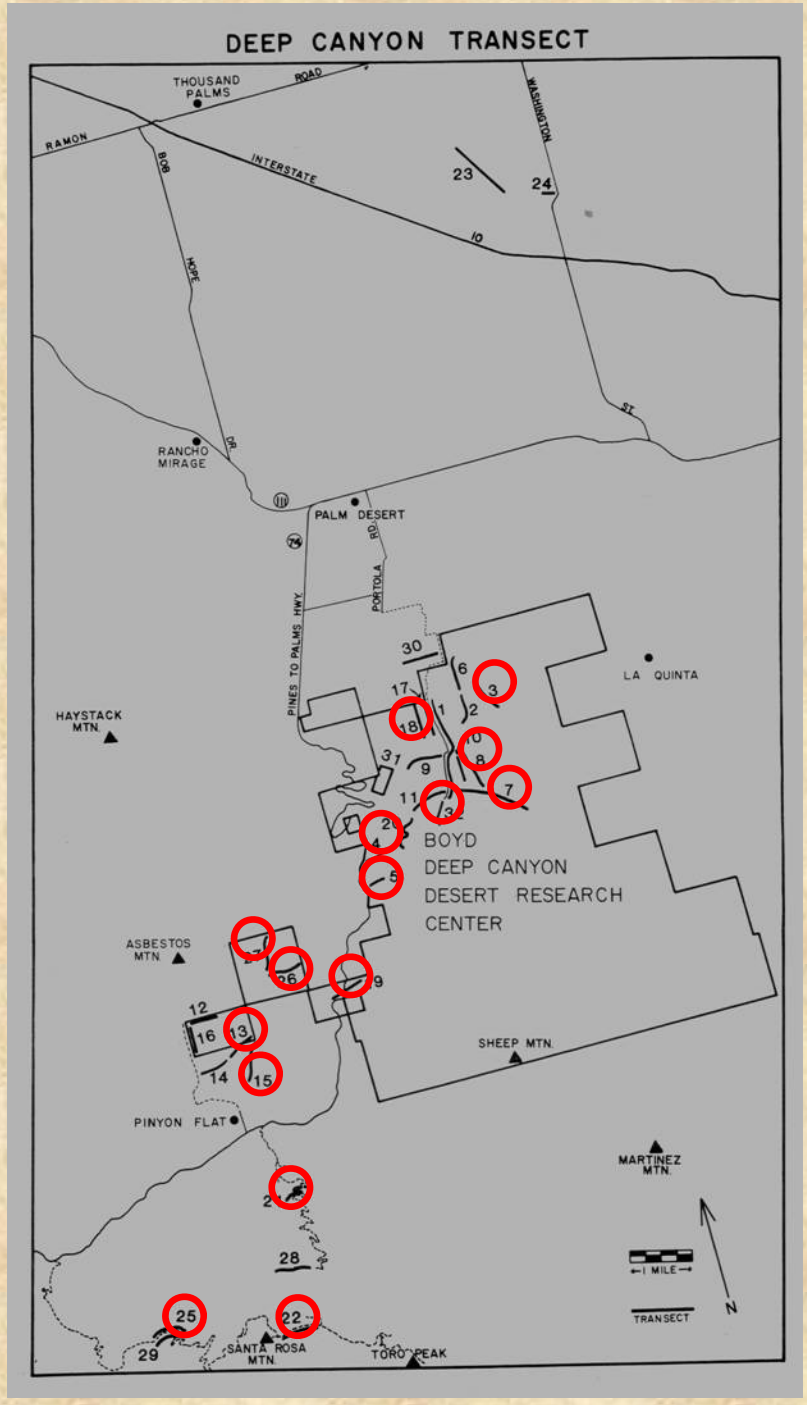
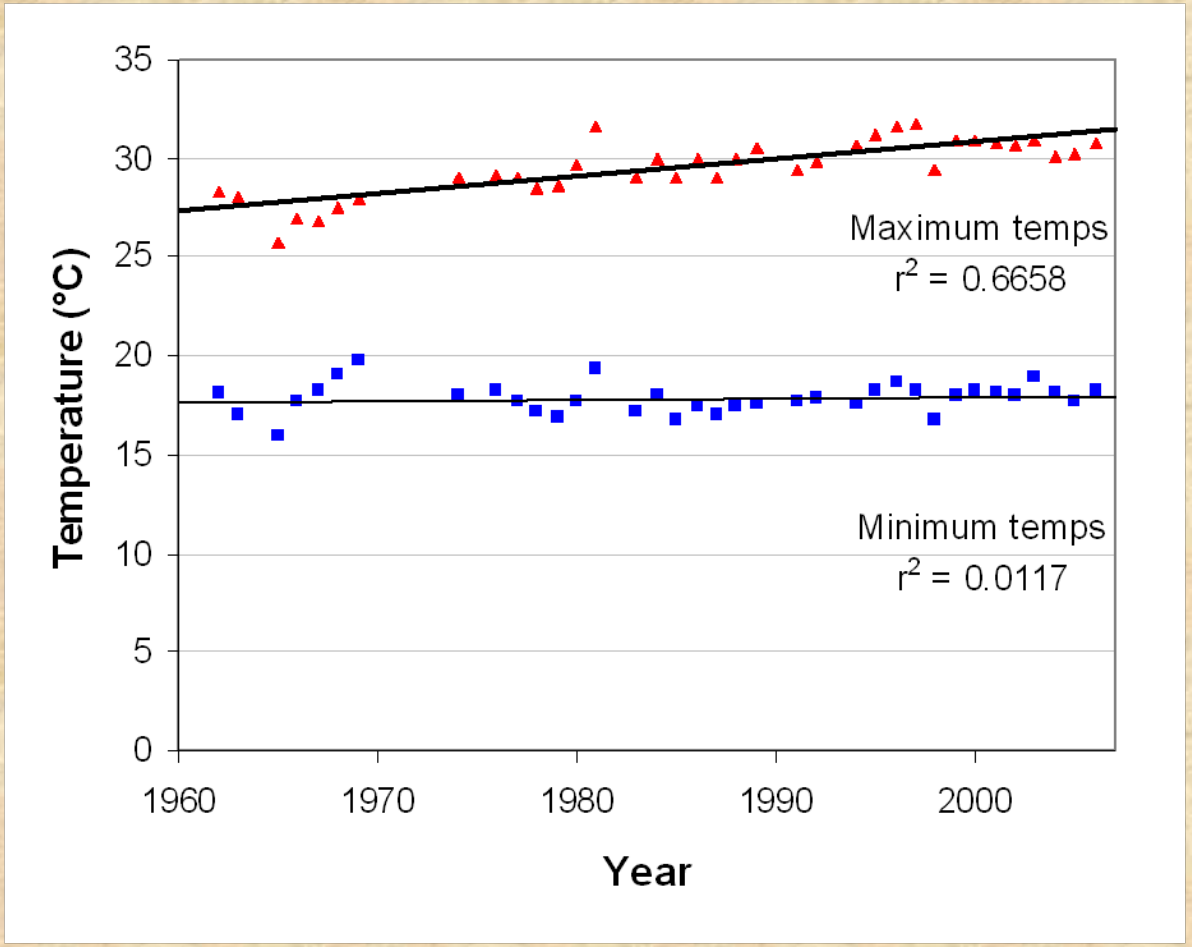
Deep Canyon Study Area

<u>26-year comparison</u>:

- 15 sites (1-km transects)
- Same methods (spring/am)
- Elevation: 200-2400m
- 1979-81 vs. 2005-07



Climate Patterns:
Deep Canyon (elevation 292 m)



<u>Mean max</u>:
+3.8°C
(since 1962, annual)

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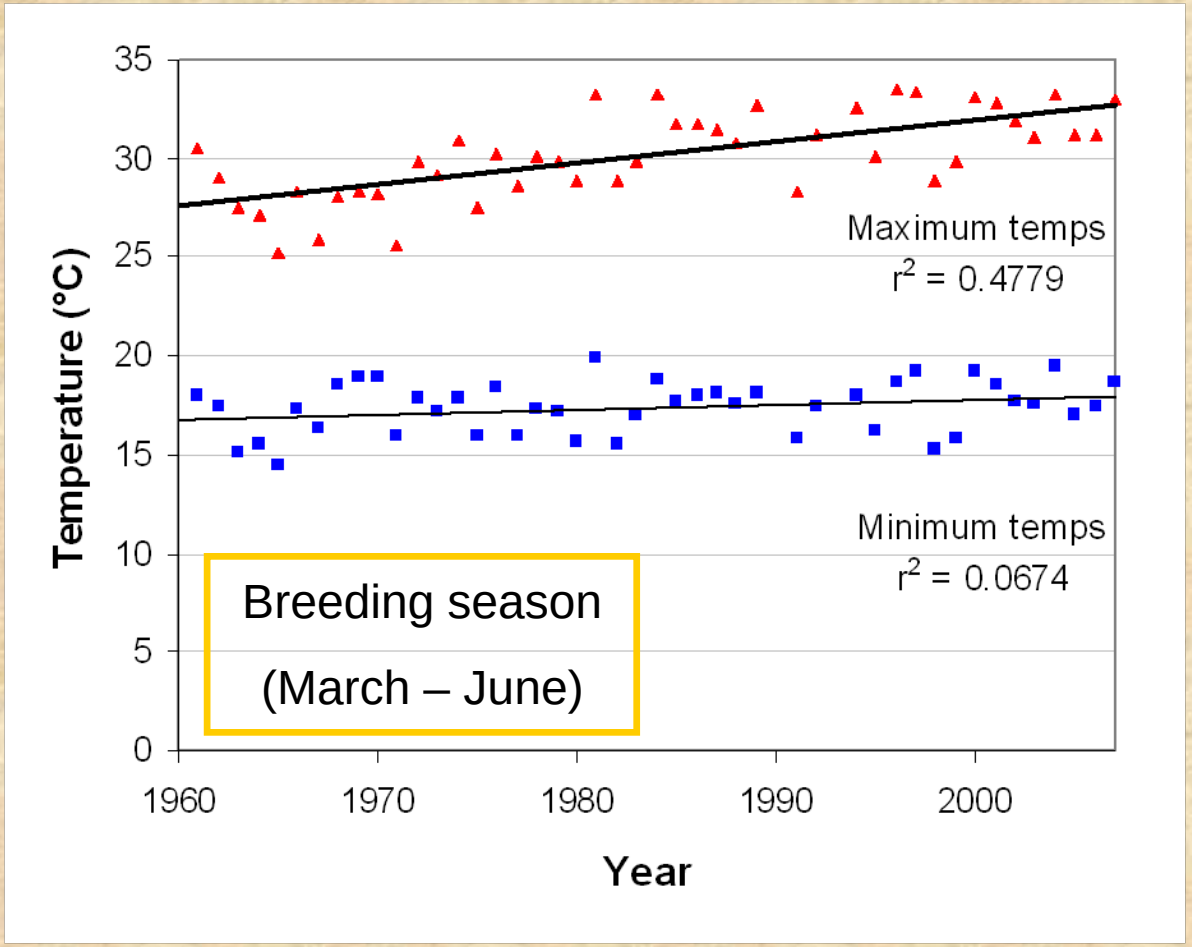
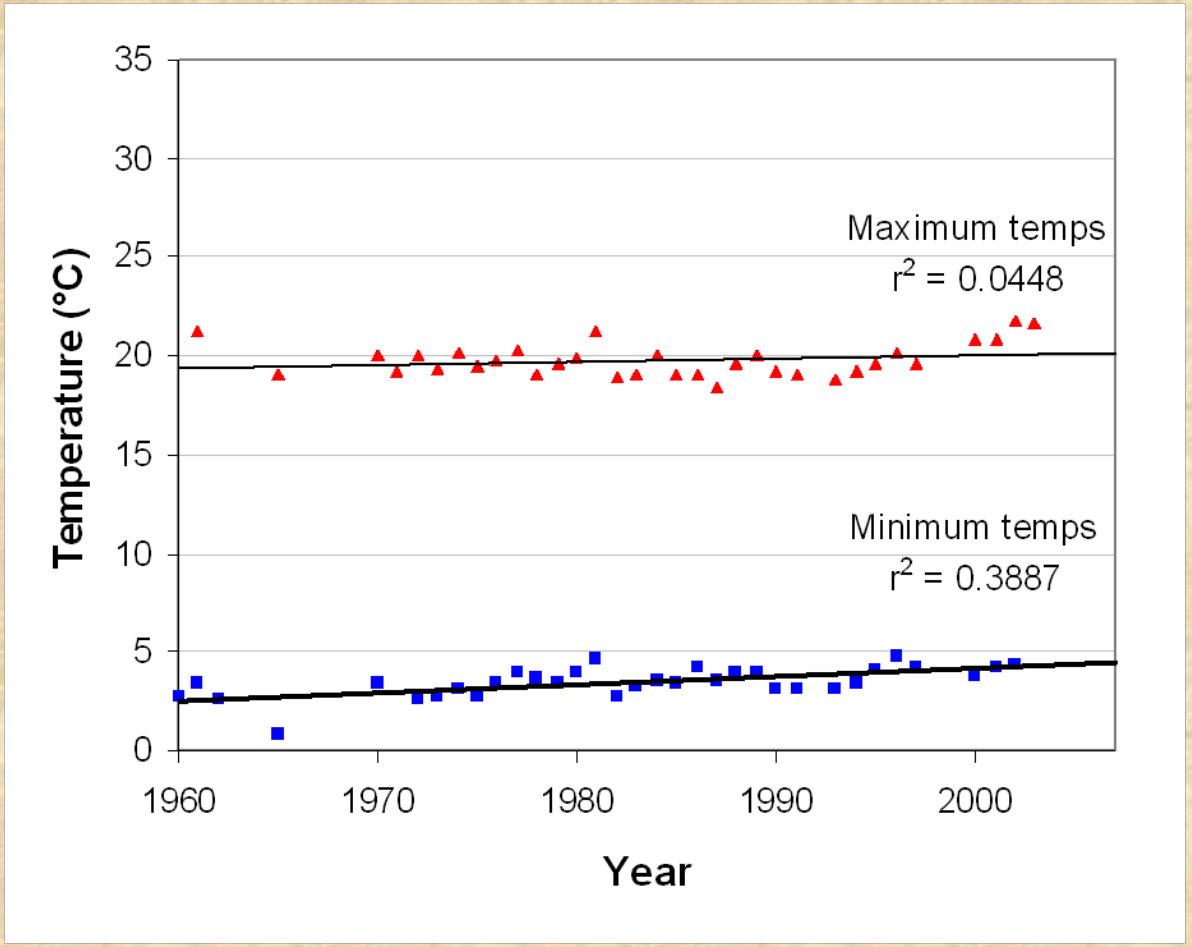


<u>Mean max</u>:
+5.0°C
(since 1961, spring months)

Climate Patterns:
Idyllwild (elevation 1640 m)



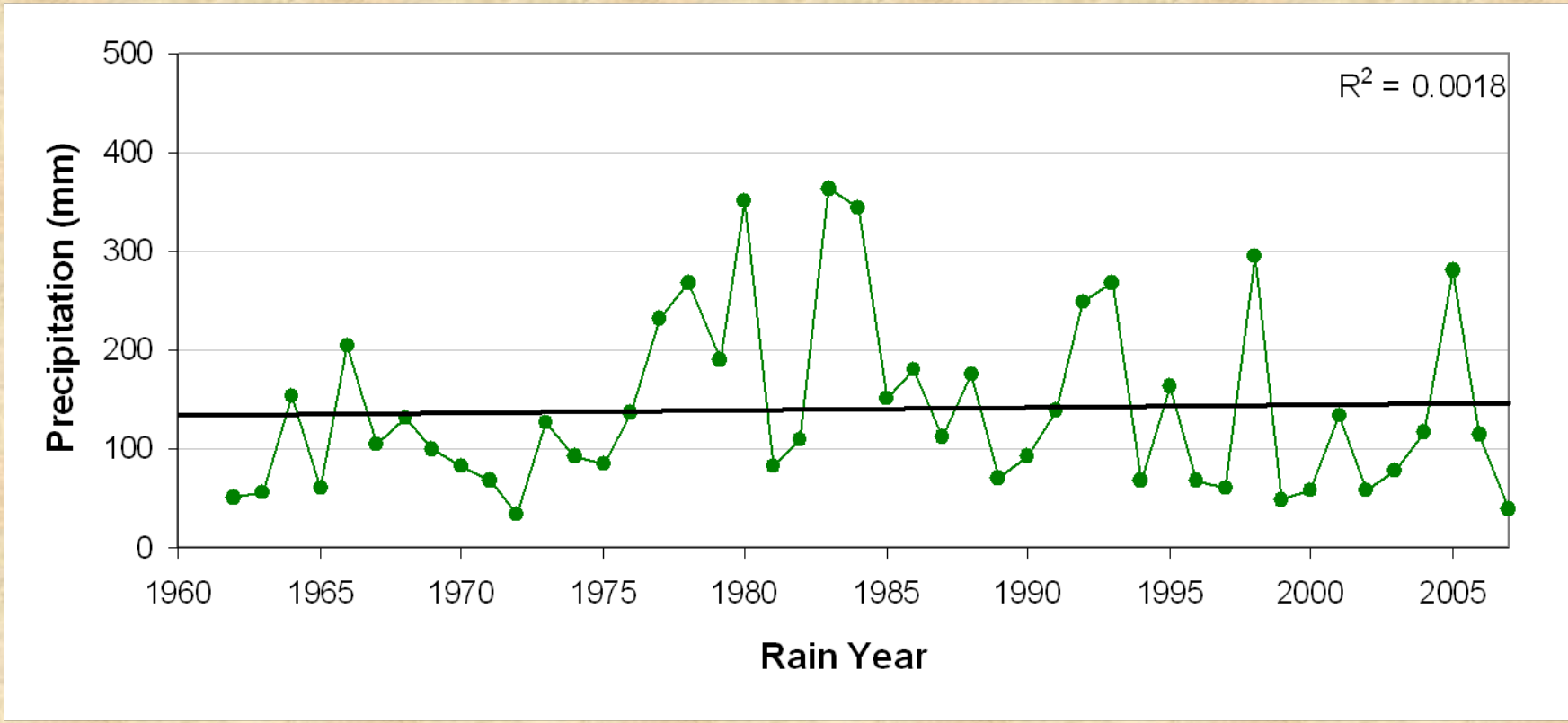
<u>Mean min</u>:
+1.7°C
(since 1960, annual)

Climate Patterns:
desert vs. mountain temperature trends

Mountains: Increase in average **LOW** temperature

Desert: Increase in average **HIGH** temperature

Climate Patterns:
Deep Canyon (elevation 292 m)



No long-term trend in precipitation since 1962

Climate Patterns:
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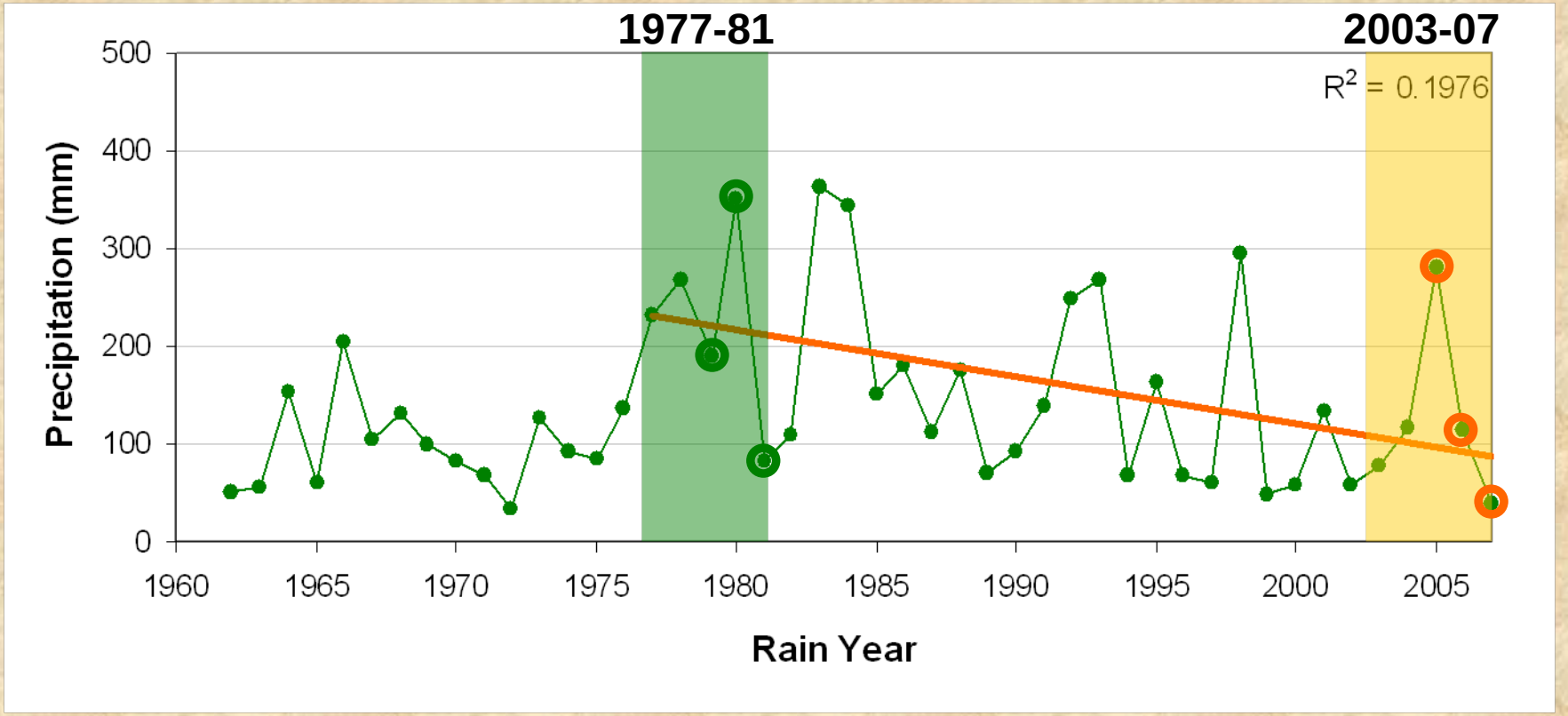

44% less precipitation in 2003-07 than in 1977-81

Are distributions shifting upward in elevation?

<u>Community composition</u>

- 3 study areas
- 2 time periods

  1979-81 vs. 2005-07

  (Deep Canyon)

<u>Individual species</u>

- Elevational distributions

  (2 time periods at Deep Cyn)

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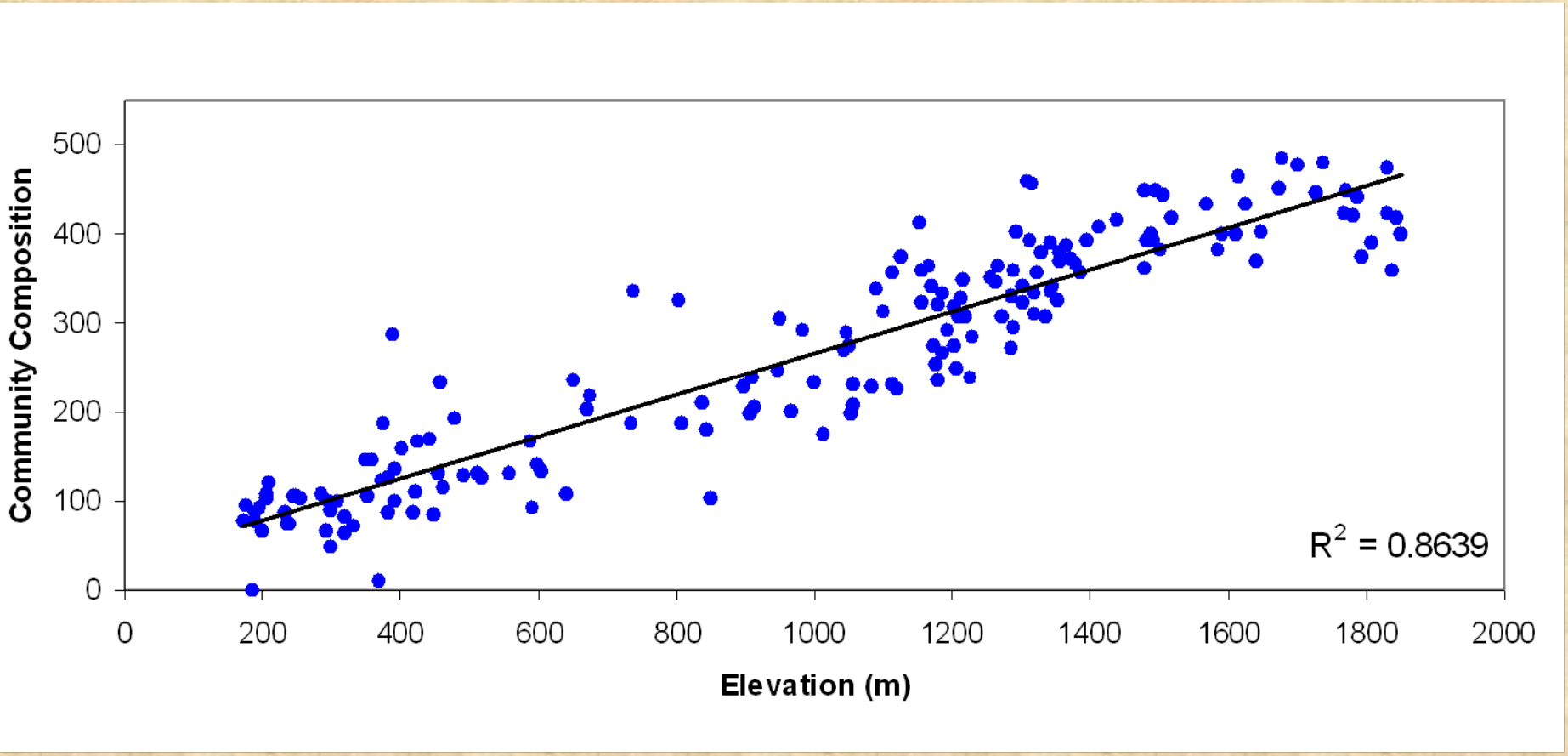
All analyses: 28 common species, standardized abundances

Community composition vs. elevation: three study areas (2005-07)



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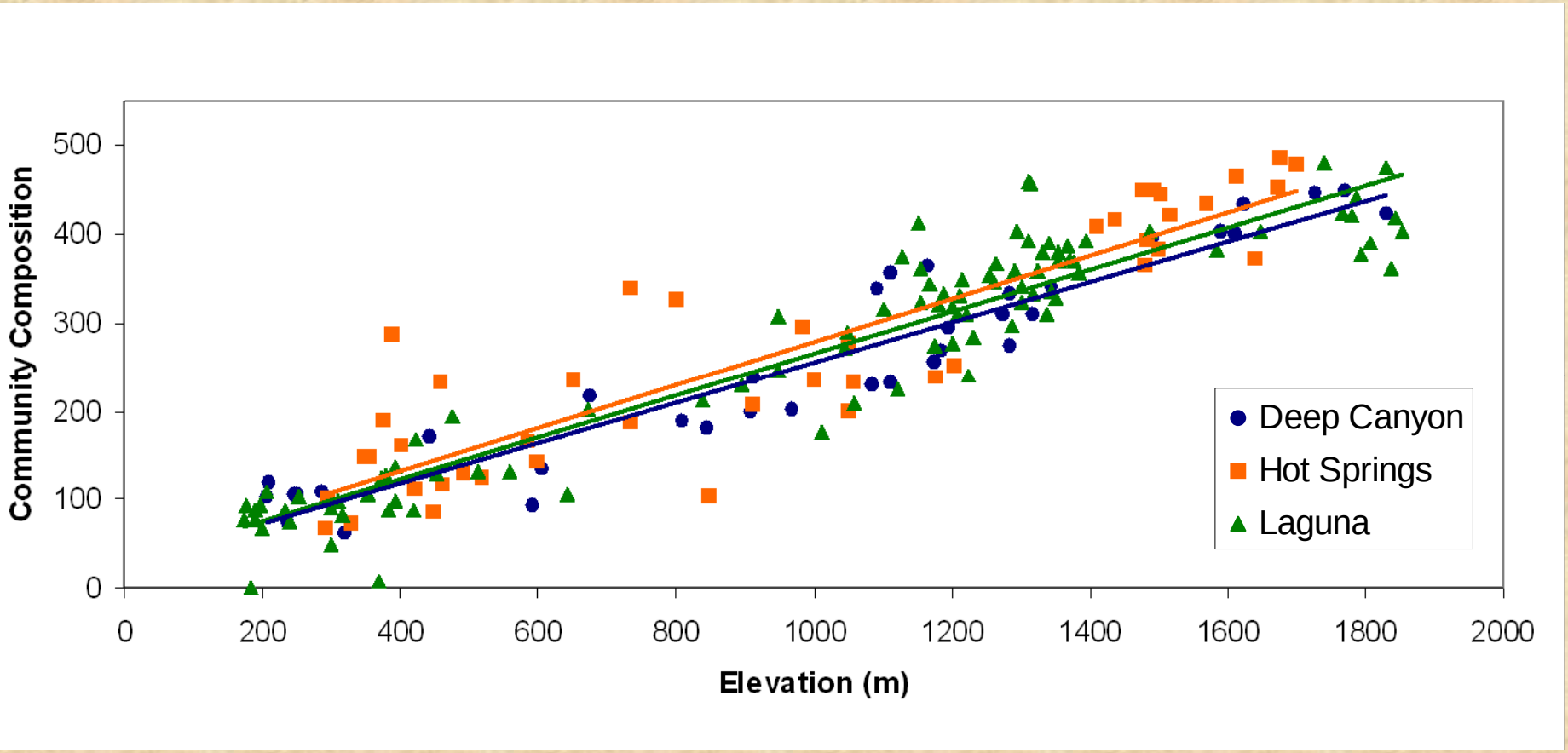
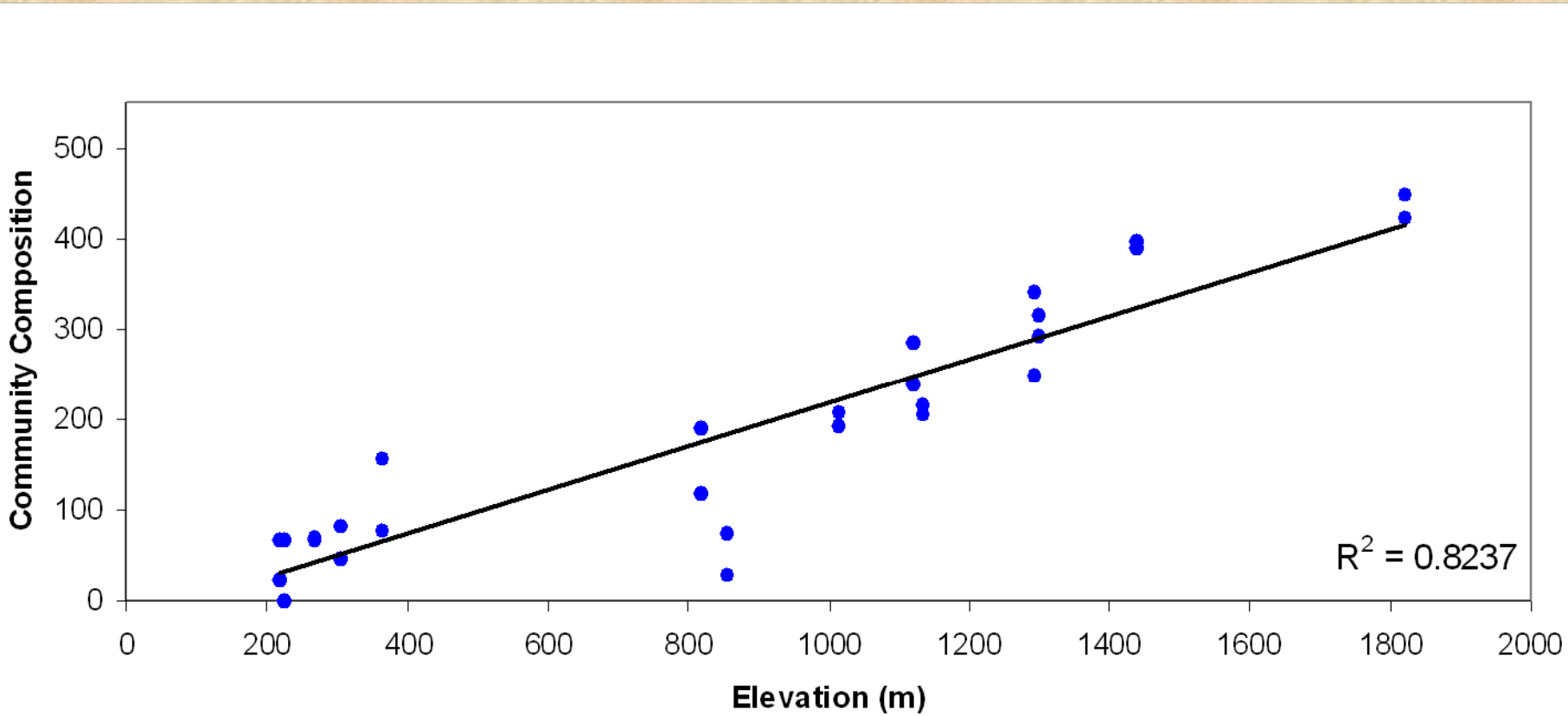


Community composition vs. elevation: two time periods (Deep Canyon)



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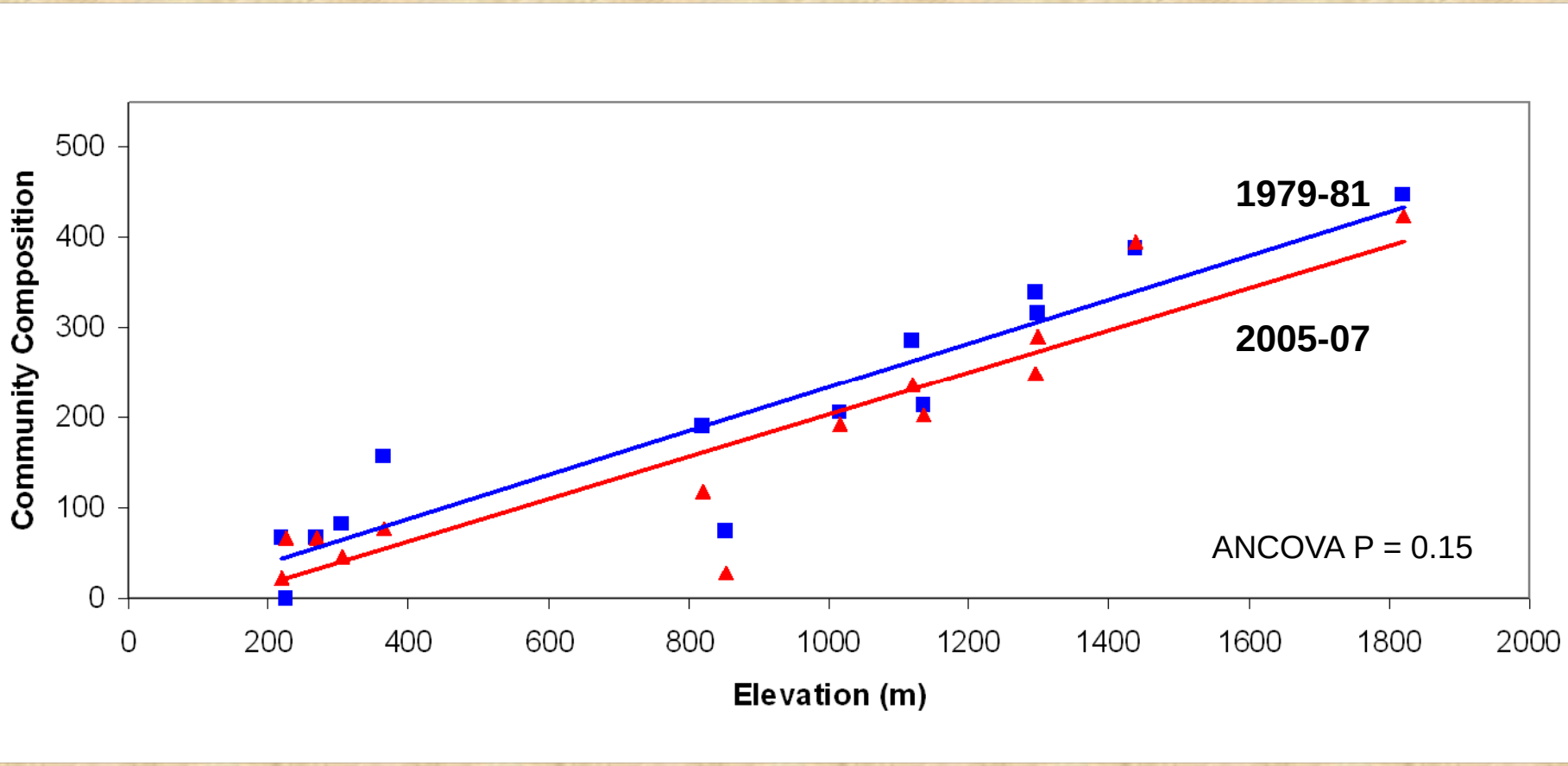

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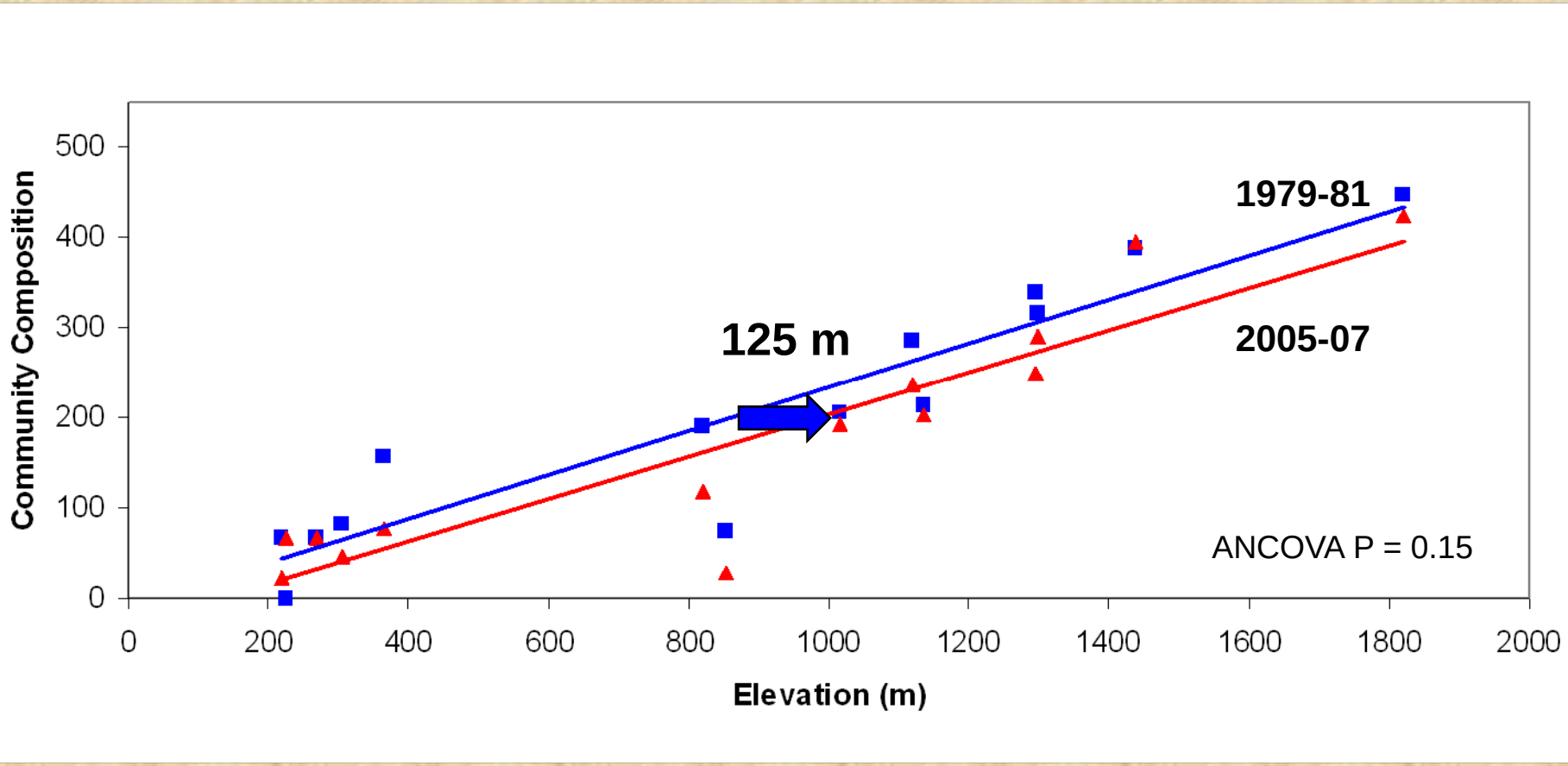
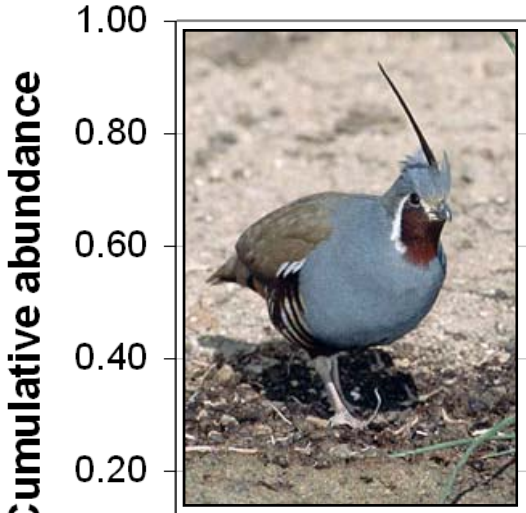


Shifts in species' distributions: Mountain Quail



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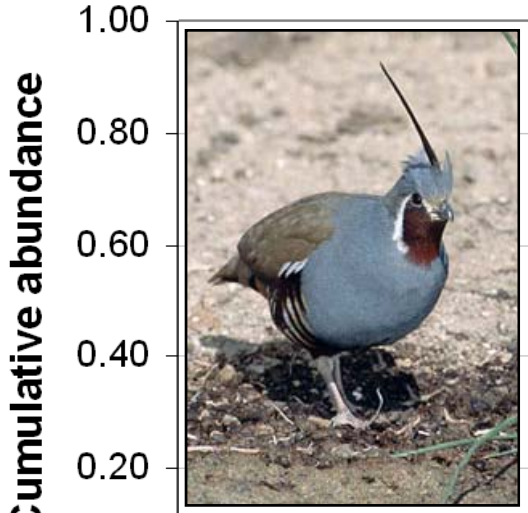
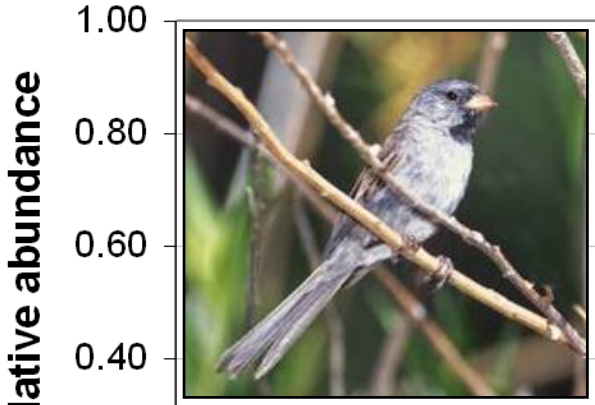


Shifts in species' distributions: Black-chinned Sparrow



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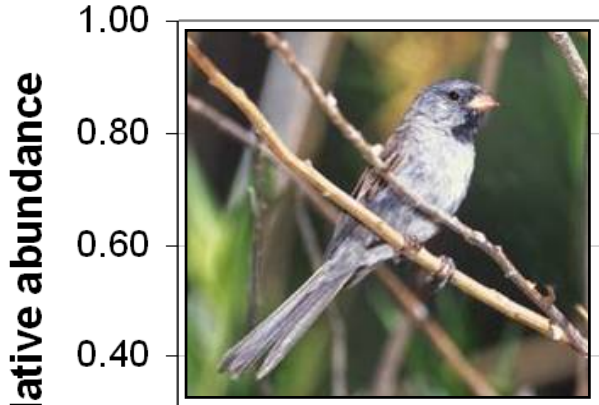
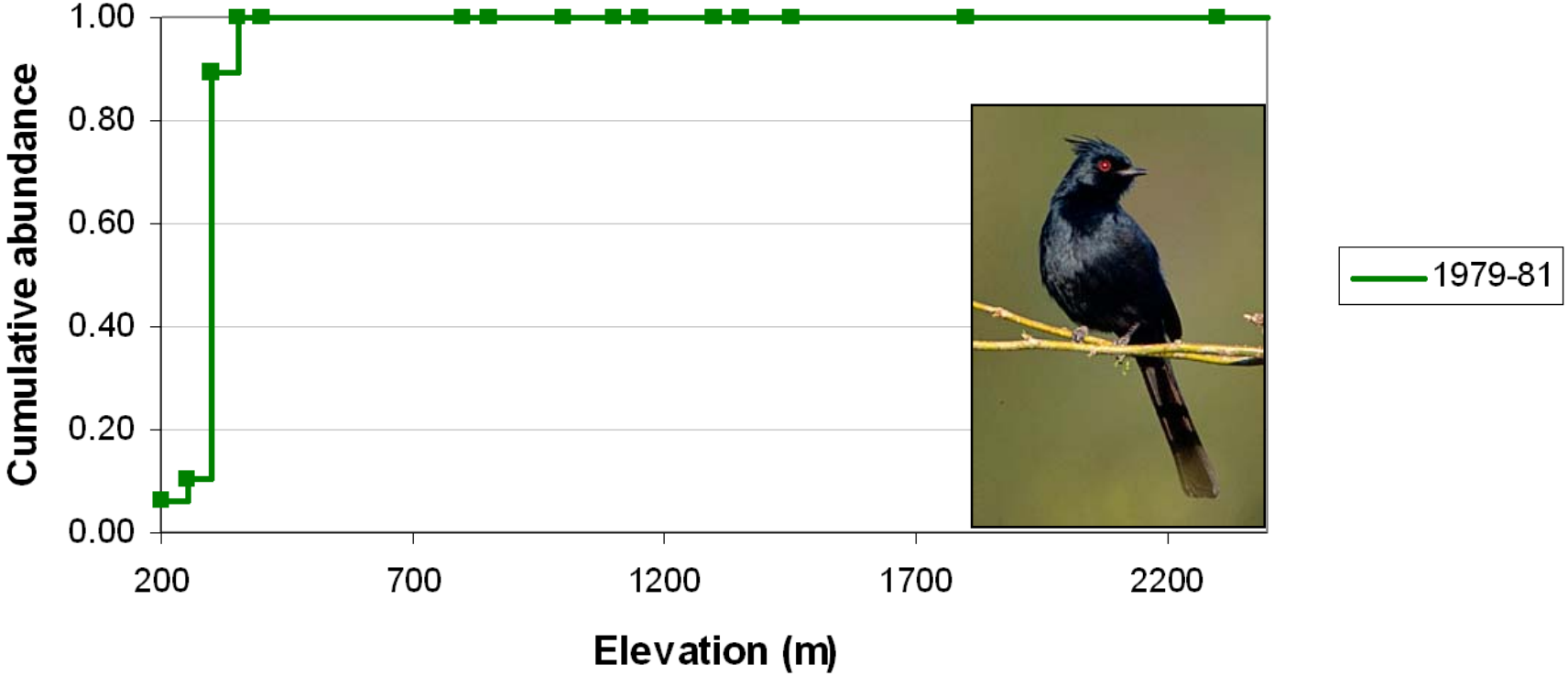


Shifts in species' distributions: Phainopepla



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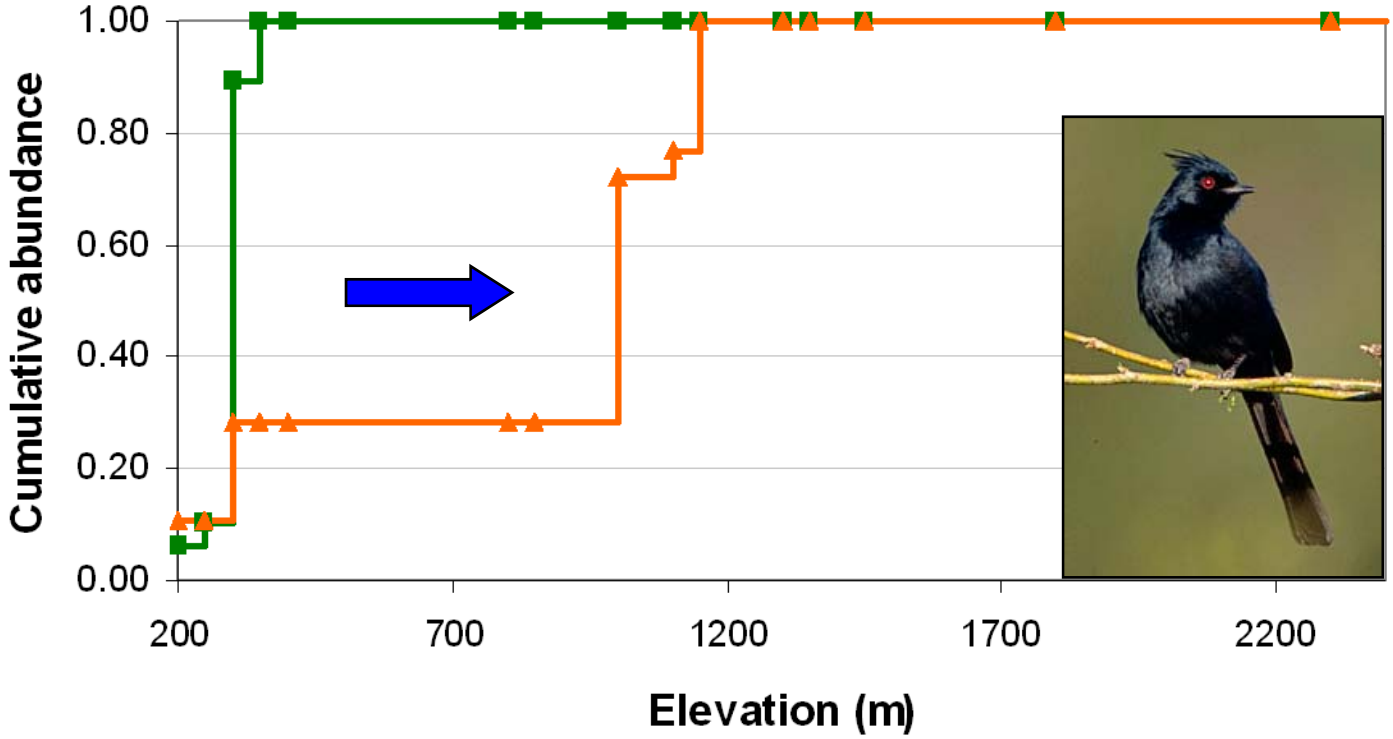
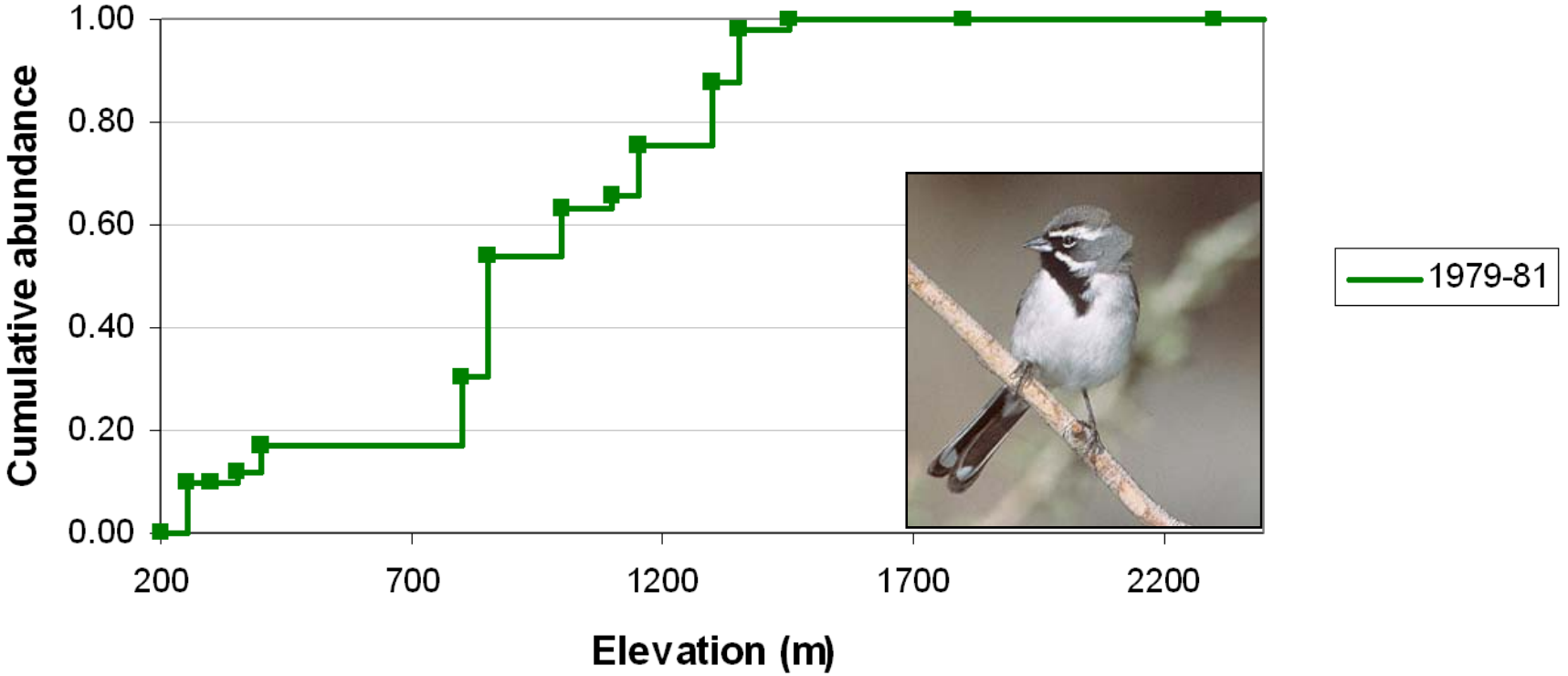
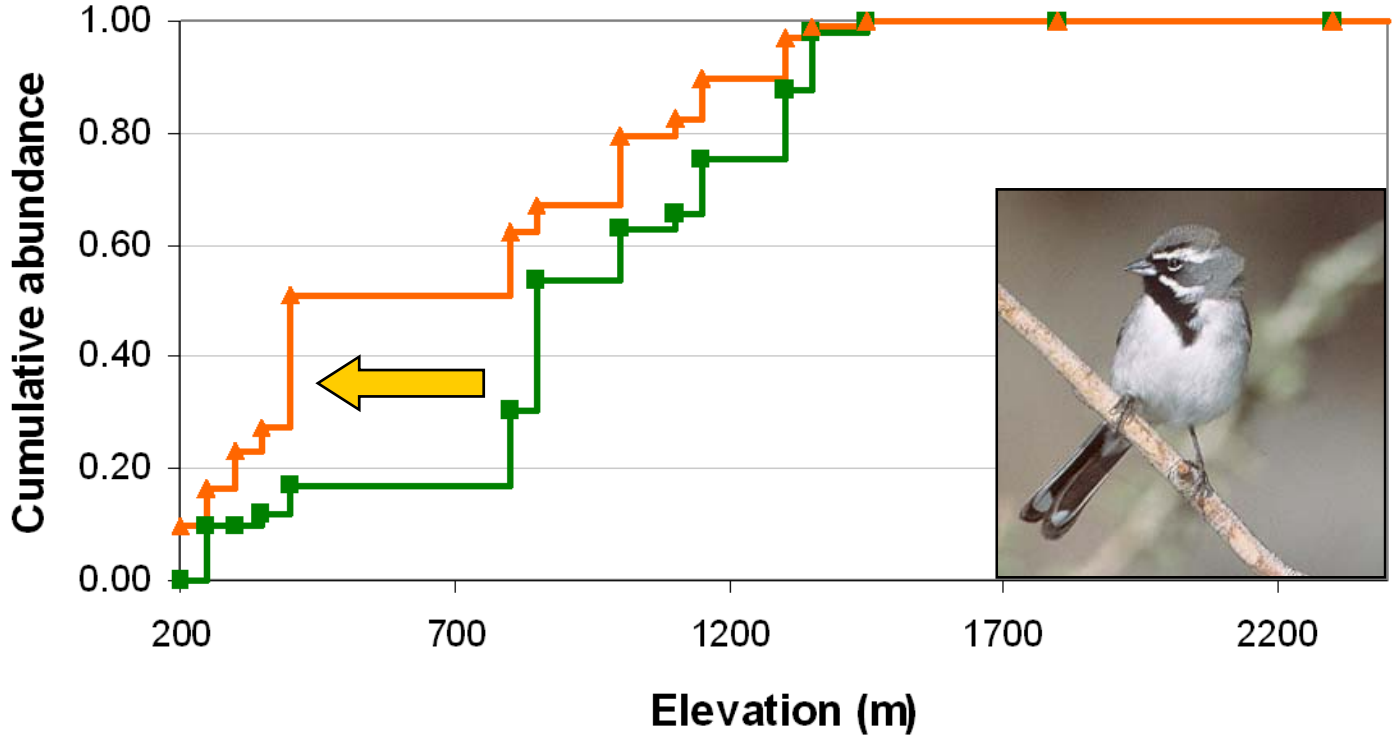


Shifts in species' distributions: Black-throated Sparrow



Shifts in species' distributions: Black-throated Sparrow



Shifts in species' distributions

Desert scrub

Species	Mean elev (m) 1979-81	Direction of shift 2005-07
Black-tailed Gnatcatcher	245	+
Verdin	248	+
Phainopepla	269	+
Northern Mockingbird	270	+
Say's Phoebe	270	+
American Kestrel	365	+
California-Gambel's Quail	487	+
Cactus Wren	530	+
Loggerhead Shrike	616	+
Rock Wren	638	+
Ladder-backed Woodpecker	820	+
Black-throated Sparrow	914	–
Scott's Oriole	929	–
Greater Roadrunner	1216	+

Chaparral-Montane

Species	Mean elev (m) 1979-81	Direction of shift 2005-07
Bushtit	1165	+
California Towhee	1262	–
Western Scrub-Jay	1290	+
Pinyon Jay	1298	–
Bewick's Wren	1351	+
Mountain Quail	1370	+
California Thrasher	1424	–
Oak Titmouse	1509	–
Spotted Towhee	1597	–
Wrentit	1598	+
Black-chinned Sparrow	1739	–
Northern Flicker	2215	–
House Wren	2314	+
Mountain Chickadee	2336	–

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Mountain Chickadee	2336	–

Shifts in species' distributions

Average elevational shift for all 28 species: **plus 116 meters** ($P < 0.01$)

Desert scrub

Species	Mean elev (m) 1979-81	Direction of shift 2005-07
Black-tailed Gnatcatcher	245	+
Verdin	248	+
Phainopepla	269	+
Northern Mockingbird	270	+
Say's Phoebe	270	+
American Kestrel	365	+
California-Gambel's Quail	487	+
Cactus Wren	530	+
Loggerhead Shrike	616	+
Rock Wren	638	+
Ladder-backed Woodpecker	820	+
Black-throated Sparrow	914	–
Scott's Oriole	929	–
Greater Roadrunner	1216	+

Chaparral-Montane

Species	Mean elev (m) 1979-81	Direction of shift 2005-07
Bushtit	1165	+
California Towhee	1262	–
Western Scrub-Jay	1290	+
Pinyon Jay	1298	–
Bewick's Wren	1351	+
Mountain Quail	1370	+
California Thrasher	1424	–
Oak Titmouse	1509	–
Spotted Towhee	1597	–
Wrentit	1598	+
Black-chinned Sparrow	1739	–
Northern Flicker	2215	–
House Wren	2314	+
Mountain Chickadee	2336	–

Shifts in species' distributions

Average elevational shift for desert species: **plus 171 meters** ($P < 0.05$)

Desert scrub

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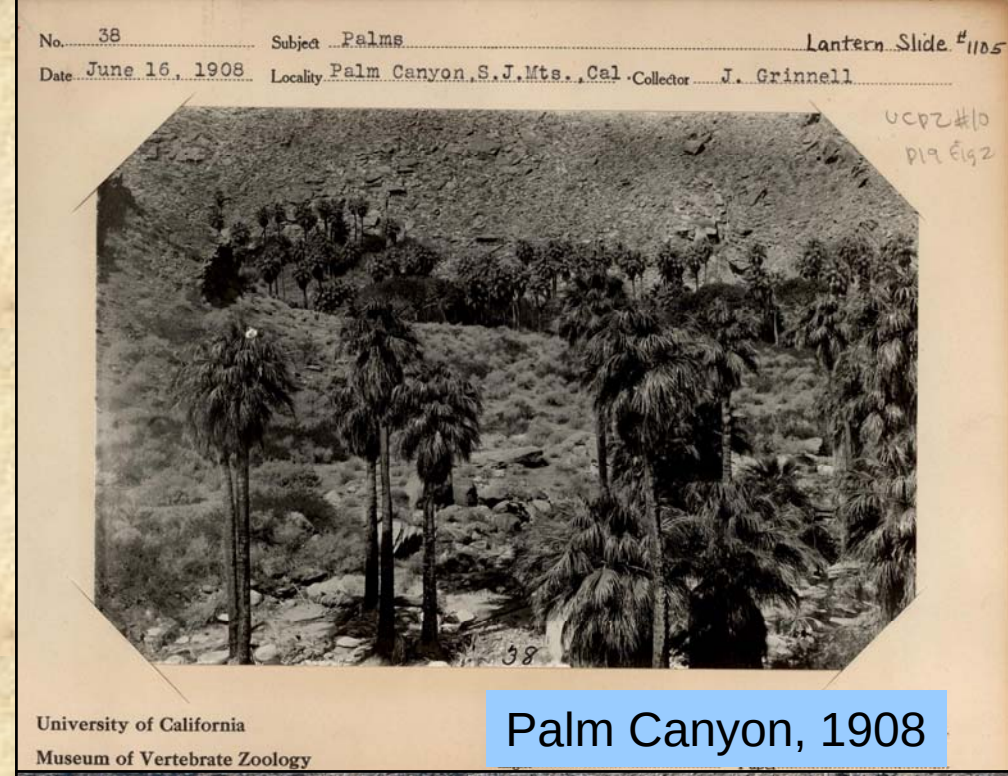
On-going research…

Large-scale distribution patterns

- Relationships with habitat/environmental variables
- Multiple spatial and temporal scales
- 26-year comparison
- 100-year comparison

100-year comparison

- San Jacinto Mountains
- 19 sites: 200-2800m
- All vertebrate species
- Centennial Resurvey
  - **1908** (Grinnell, MVZ)
  - **2008-10** (SDNHM)



Palm Canyon, 1908

Palm Canyon, 2008

100-year comparison

- San Jacinto Mountains
- 19 sites: 200-2800m
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- Centennial Resurvey
  - **1908** (Grinnell, MVZ)
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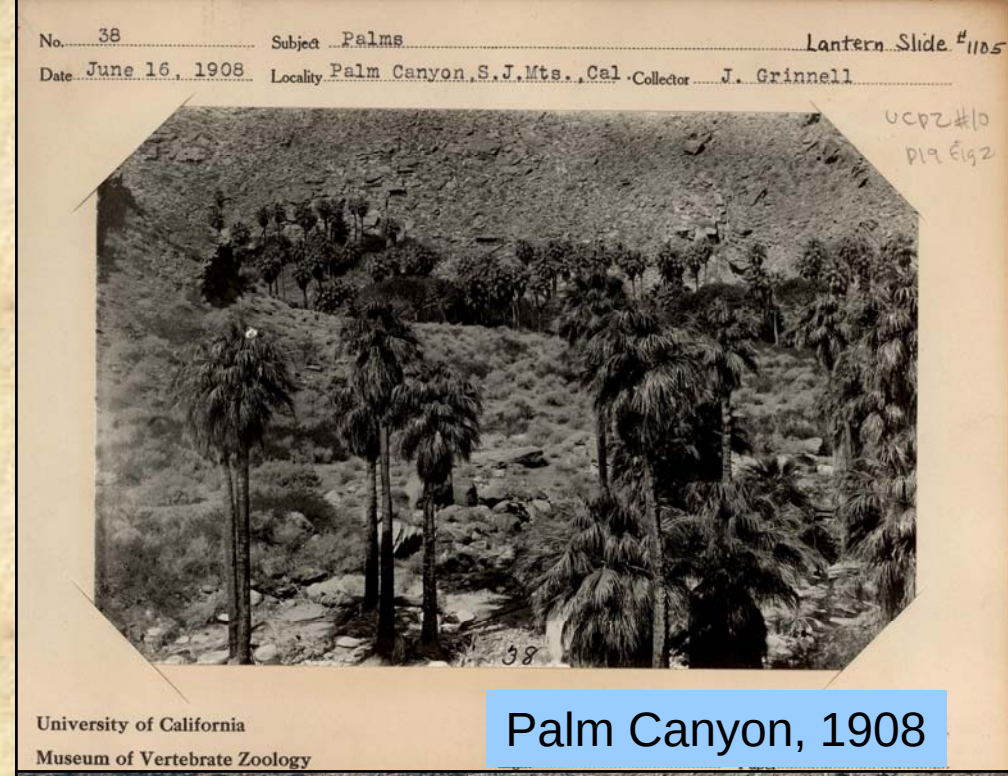
Project website:
www.sdnhm.org/research/sanjacinto



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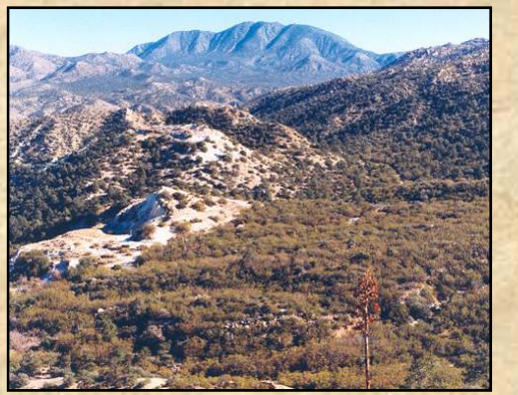
Local-scale performance

- Breeding/nesting success at distribution margins
- 24 20-ha plots with weekly surveys 2006-2008

Summary: 26-year comparison

- Climate change in this system: warmer and drier
  - Very rapid increase in ‘daily high’ temperature on desert floor
  - Strong differences in trends at high vs. low elevations



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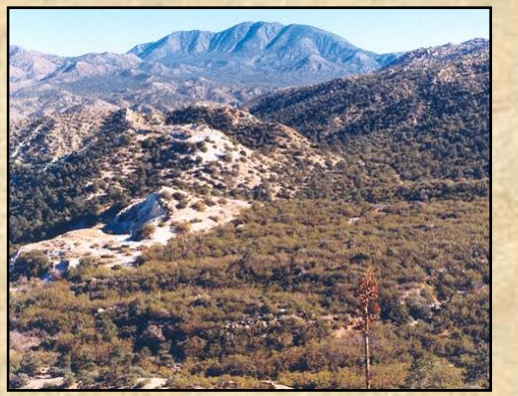
- Breeding bird species have shifted upward in elevation over a 26-year period (115-125 m average)



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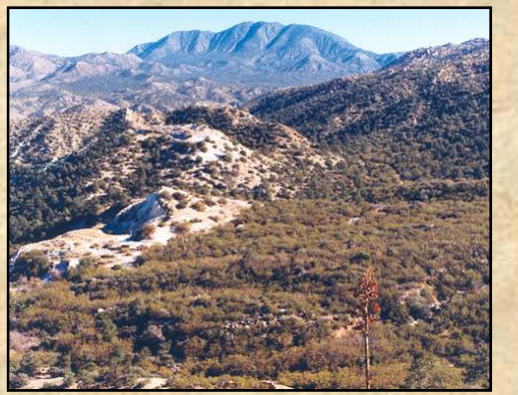
- Desert species more likely to show upward shifts



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Thank you!

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